Raymarine®

SmartPilot X-5R
Drive Installation & Setup

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Preface

Safety notices

WARNING: Product installation & operation
This equipment must be installed, commissioned and operated in accordance with the Raymarine instructions provided. Failure to do so could result in personal injury, damage to your boat and/or poor product performance.

WARNING: Switch off power supply
Make sure you have switched off the power supply before you start installing this product.

WARNING: Navigational safety
Although we have designed this product to be accurate and reliable, many factors can affect its performance. Therefore, it should serve only as an aid to navigation and should never replace commonsense and navigational judgement. Always maintain a permanent watch so you can respond to situations as they develop.

EMC Conformance

All Raymarine equipment and accessories are designed to the best industry standards for use in the recreational marine environment. Their design and manufacture conforms to the appropriate Electromagnetic Compatibility (EMC) standards, but correct installation is required to ensure that performance is not compromised.

Pressure washing

Subjecting any Raymarine product to high pressure washing may cause subsequent water intrusion and failure of the product. Raymarine will not warranty product subjected to high pressure washing.

Product documents

This document is part of a series of books associated with the SmartPilot X-5R series. Documents can be downloaded from www.raymarine.com/handbooks.

Title	Part number
SmartPilot X-5R Drive Operating Guide	81329
ST6002 SmartPilot Controller - Drive Quick Reference Guide	86140
Fluxgate compass installation sheet	87011

To the best of our knowledge, the information in the product documents was correct when they went to press. However, Raymarine cannot accept liability for any inaccuracies or omissions in product documents.

In addition, our policy of continuous product improvement may change specifications without notice. Therefore, Raymarine cannot accept liability for any differences between the product and the accompanying documents.

Warranty

To register your new Raymarine product, please take a few minutes to fill out the warranty card. It is important that you complete the owner information and return the card to us to receive full warranty benefits. You can also register online at www.raymarine.com by following the **Login or create an account** link.

Product disposal

Waste Electrical and Electronic (WEEE) Directive

The European WEEE Directive requires that waste electrical and electronic equipment is recycled.

Products carrying the crossed out wheeled bin symbol (illustrated above) must not be disposed of in general waste or landfill, but in accordance with local regulations for such products.

Although the WEEE Directive does not apply to all Raymarine products, we support its policy and ask you to be aware of the correct method for disposing of such products.

Please contact your local dealer, national distributor or Raymarine Technical Services for information on product disposal.

Chapter 1: Installation and system overviews

This chapter gives an overview of installation procedures and network configurations for an SPX-5R Drive system.

The SmartPilot X-5R (SPX-5R) Drive system is intended for use as an aid to steering leisure marine craft with a fully-laden displacement up to a maximum of:

- 4400 pounds (2000 kg) for mechanically steered craft.
- 7500 pounds (3500 kg) for power steered craft.

1.1 Installation overview

There are two stages to installing an SPX-5R Drive system, namely planning the installation, then installing and mounting the components.

It is important to carry out the planning stage, to ensure that all components used in the system, including cables and accessories, are correctly specified and located.

The following is a summary of the tasks in each stage.

Planning

1. Understand your system.
2. Check equipment supplied.
3. Establish suitable locations for the autopilot equipment.
4. Plan cabling and connections.
5. Produce a schematic diagram.

Installing

1. Mount the Course Computer.
2. Install Drive unit.
3. Install the autopilot controller.
4. Install the compass.
5. Connect power cables and system ground.
6. Connect additional equipment / cables to the course computer.
7. Final fix: secure all equipment in place; secure all cables.

1.2 Safe and successful installation

To achieve a safe and reliable installation of your SPX-5R Drive system, installation must be carried out by a competent professional who should adhere to the instructions in this guide.

Certified installation

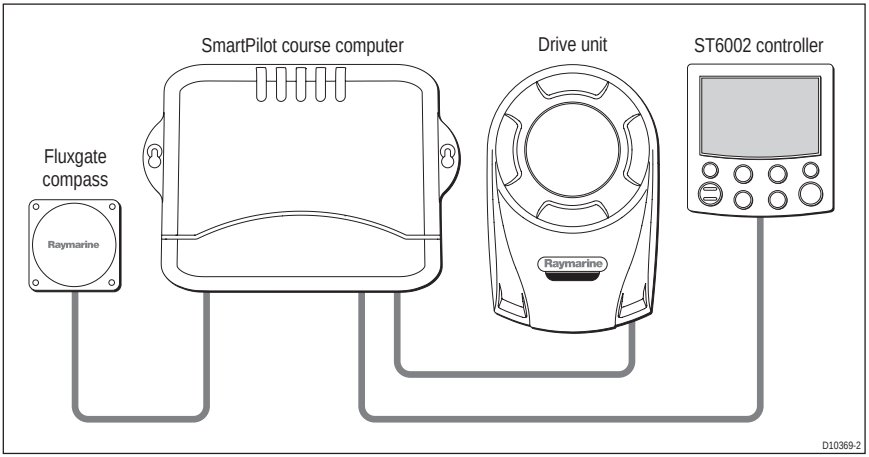
Raymarine recommends certified installation by a Raymarine approved installer. A certified installation qualifies for enhanced warranty benefits. Contact your Raymarine dealer for further details and refer to the separate warranty document packed with your product.

Getting assistance

If you need further assistance with an installation, contact your dealer or visit the Raymarine web site **www.raymarine.com**.

Product documents

The SPX-5R Drive system consists of a number of components connected together using a Raymarine SeaTalk bus.



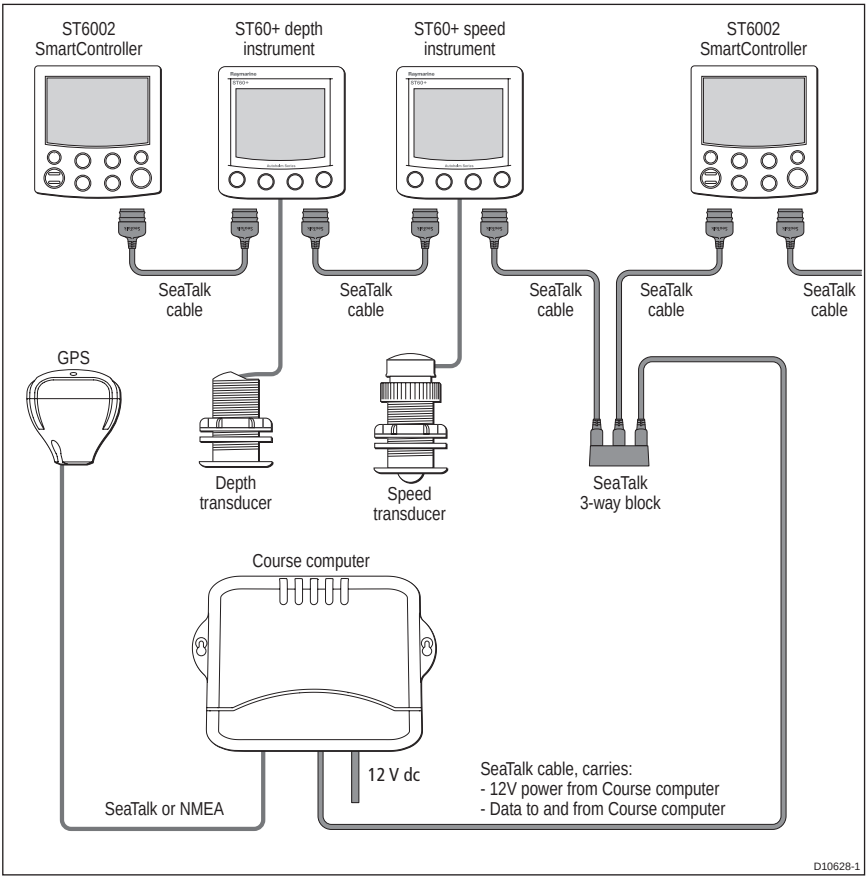
Marine electronics systems

The autopilot may form part of your wider ship's electronics system, and may be connected to equipment using a number of marine industry standard protocols, including:

- SeaTalk.
- SeaTalk^{ng}
- NMEA 0183
- NMEA2000 (via SeaTalk^{ng})

Example SeaTalk system

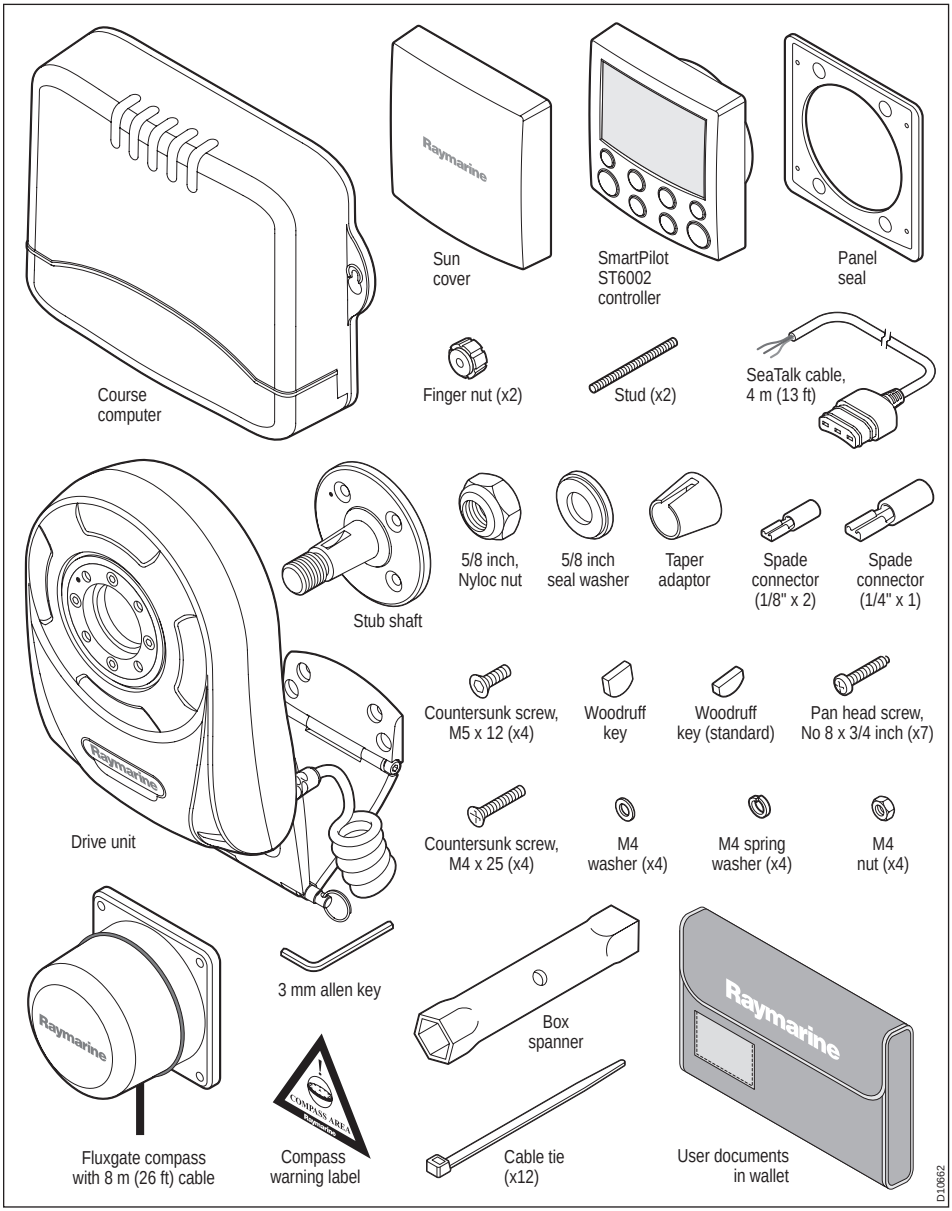
SeaTalk allows connection of compatible products though a dedicated data bus, to allow information sharing around the ship.



1.3 Equipment & Tools

Before you begin ensure you have all the necessary components and tools to install your system.

Parts supplied



Tools and equipment NOT supplied

You will need to supply the following equipment and tools:

Tools:

- Flat bladed screwdriver
- Power drill (cordless recommended).
- Bearing puller (optional - to remove the steering wheel).
- $^{5}/_{32}$ in (4 mm) drill.
- Suitable wrenches/spanners.

Cables / equipment

- Power cable and fuse/breaker. See *page 20*.
- Additional data cables (e.g. for connection of GPS or chartplotter).
- Grounding braid. See *page 25*.

1.4 Create a schematic diagram

As part of the preparation for installing your SPX-5R Drive system, we recommend that you create a schematic diagram representing the system you want to install. This will help ensure that you install a safe optimum system, and so is particularly important if you intend connecting your autopilot to other electronic equipment.

The schematic diagram should include:

- Location of all components. See *page v* and *page 7* for EMC guidelines that may affect the location of specific components.
- Connectors, cable types, routes and lengths.

When you have completed the schematic diagram, you are ready to begin installing the SPX-5 Drive system.

Chapter 2: Installing the system

Before proceeding with the installation, ensure you have the following to hand:

- All necessary equipment and tools to install your SPX-5R Drive system.
- The correct type and length of power cable.
- Schematic diagram detailing autopilot system location and connections.

You should also check that existing marine electronics, such as the GPS are installed and working.

2.1 Installation requirements

WARNING: Install at dockside

For safety reasons your boat must be securely moored at dockside with power switched off, before commencing installation.

EMC installation guidelines

Raymarine equipment and accessories conform to the appropriate Electromagnetic Compatibility (EMC) regulations. This minimizes electromagnetic interference between equipment, which could otherwise affect the performance of your system.

Correct installation is required to ensure that EMC performance is not compromised.

For optimum EMC performance, we recommend that:

- Raymarine equipment and the cables connected to it are:
  i. At least 3 ft (1 m) from any equipment transmitting or cables carrying radio signals e.g. VHF radios, cables and antennas. In the case of SSB radios, the distance should be increased to 7 ft (2 m).
  ii. More than 7 ft (2 m) from the path of a radar beam. A radar beam can normally be assumed to spread 20 degrees above and below the radiating element.
- The product is supplied from a separate battery from that used for engine start. This is important to prevent erratic behavior and data loss which can occur if the engine start does not have a separate battery.
- Raymarine specified cables are used.
- Cables are not cut or extended unless doing so is detailed in the installation manual.

Remember

Where constraints on the installation prevent any of the above recommendations:

- Always allow the maximum separation possible between different items of electrical equipment. This will provide the best conditions for EMC performance for the installation.

Suppression ferrites

Raymarine cables may be fitted with suppression ferrites. These are important for correct EMC performance. Any ferrite removed to facilitate installation must be replaced in the original position immediately after the installation is complete.

- Use only ferrites of the correct type, supplied by Raymarine authorized dealers.

Connections to other equipment

If Raymarine equipment is to be connected to other equipment using a cable not supplied by Raymarine, a Raymarine suppression ferrite MUST always be attached to the cable near the Raymarine unit.

Compass

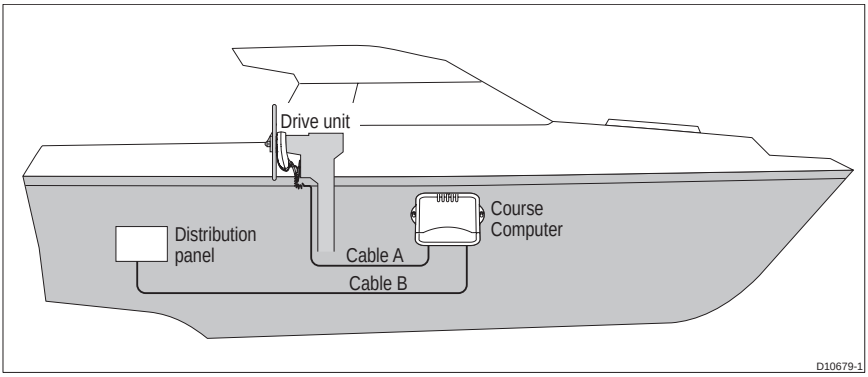
The compass is sensitive to magnetic influences and other potential sources of interference including engines and VHF radio waves. To ensure optimum operation it is essential to locate the compass correctly.

2.2 General cabling guidelines

- The power cable attached to the drive unit MUST be left intact. Coil and tie any excess, do NOT cut or otherwise remove it.
- Do not mix ac and dc cables.
- Adhere to EMC guidelines (see *page 7*).
- Use Kopex conduit where appropriate to protect cables.
- Label all cables for easy identification
- Keep the Fluxgate compass cable separate from other cables.

Power cable requirement

An overview of the power cables is given in the following illustration.



CAUTION: Power cable

Using an incorrect size of power cable could reduce the power supplied to the drive unit and therefore cause your SPX-5R Drive system to malfunction. Ensure the correct cable size is used. If in doubt, use a heavier gauge cable.

The requirement for power cables depends on the total length of the power circuit. In the above illustration, that is the total length of Cable A + Cable B.

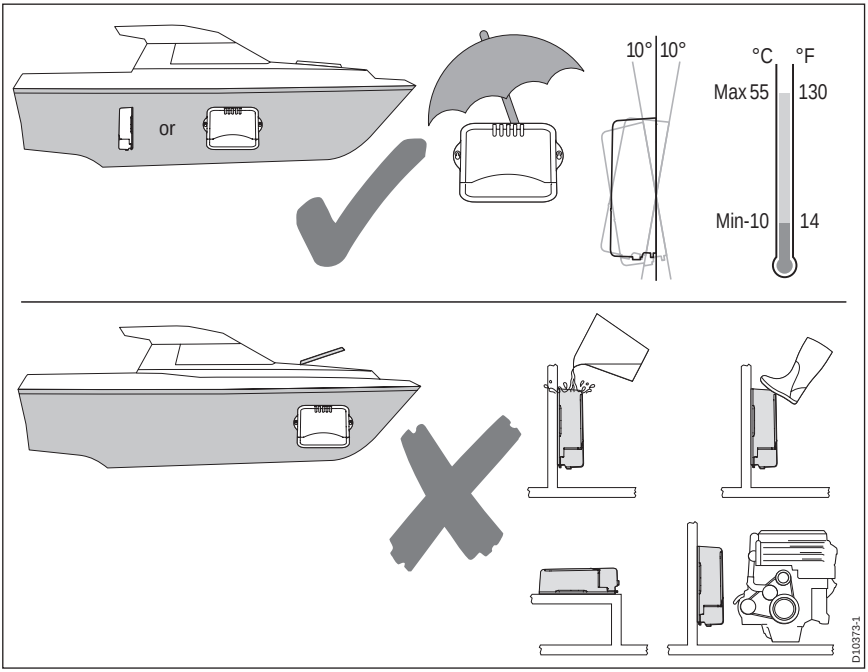
The correct cable dimensions for various cable lengths are given in the following table.

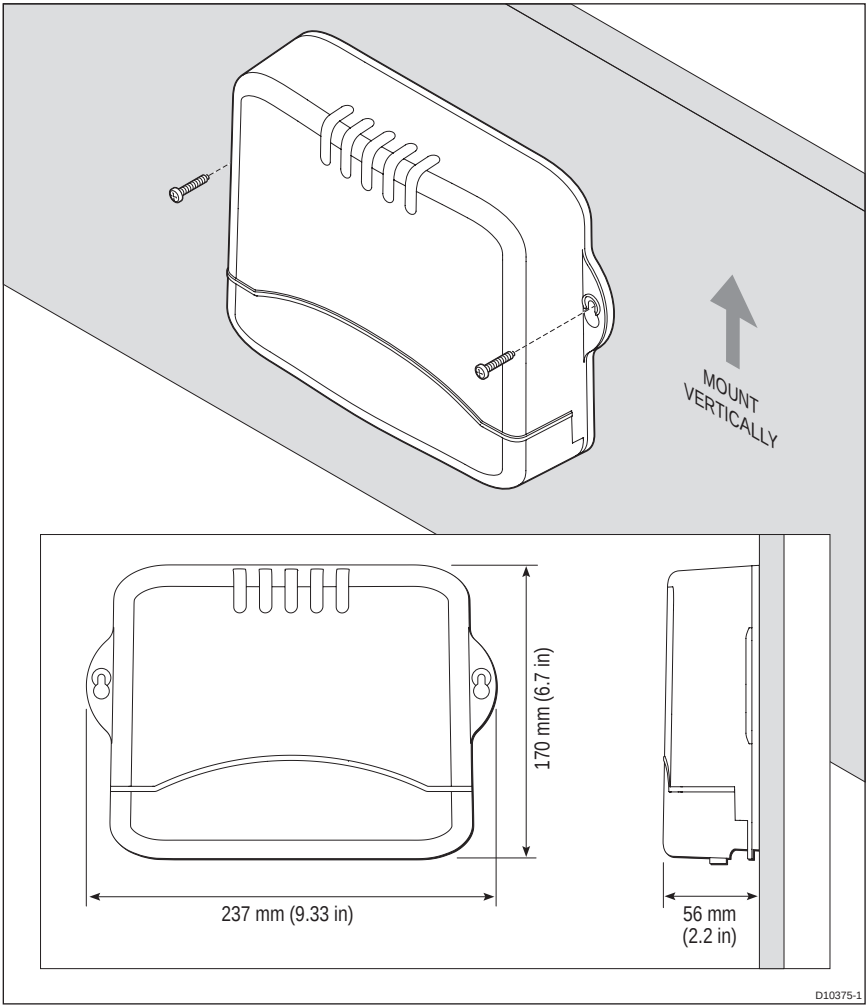
Total cable length (A + B)	Copper area	AWG
Up to 3.0 m (10 ft)	2.5 mm^2	14
Up to 5.0 m (16ft)	4 mm^2	12
Up to 7.0 m (23 ft)	10 mm^2	8

2.3 SPX-5R Drive system Course Computer

Mounting

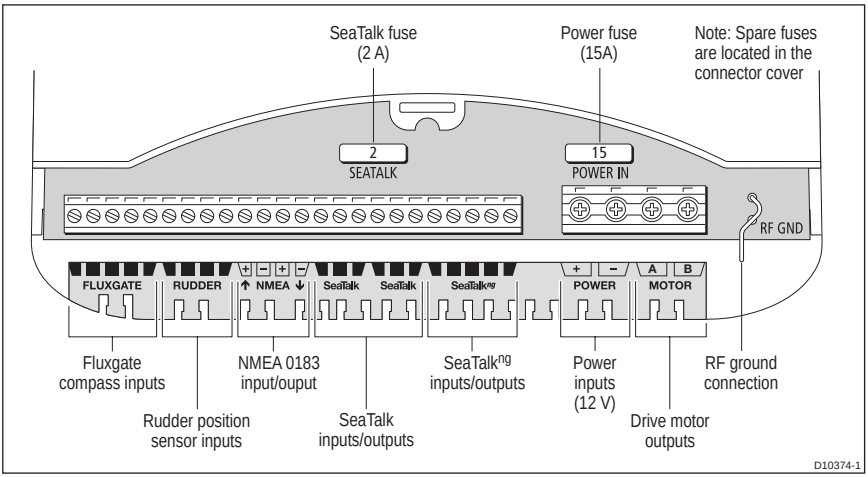
The Course Computer must be mounted on a secure vertical surface, free from vibration.




MOUNT
VERTICALLY
170 mm (6.7 in)
237 mm (9.33 in)
56 mm
(2.2 in)
D10375-1

Connection overview

The Course Computer provides the following system connections



2.4 Mounting the Drive

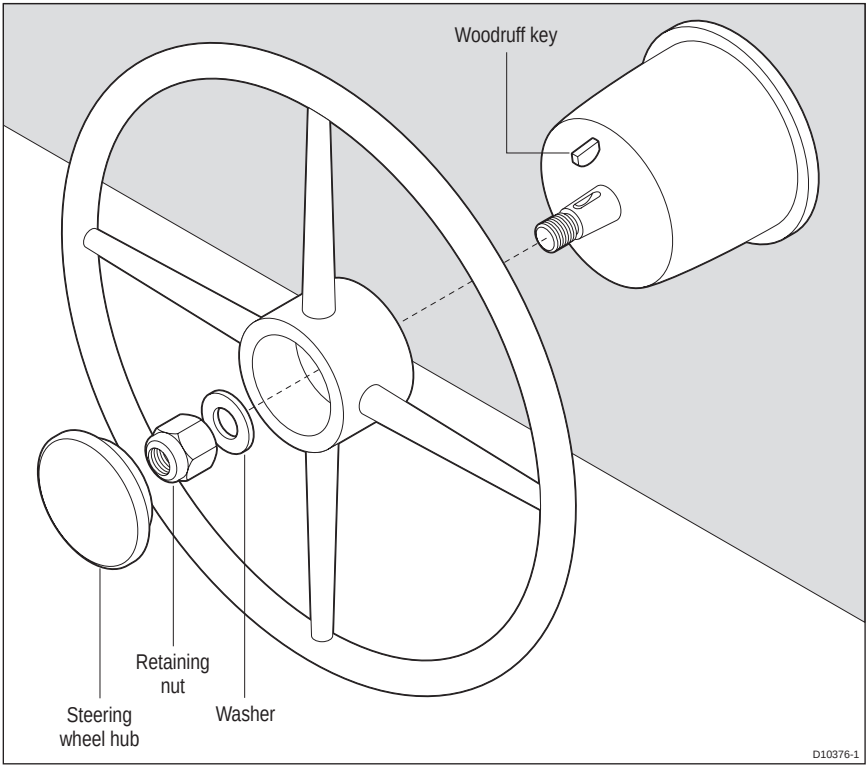
The Drive fits over your boat's existing steering shaft, and the steering wheel is secured to the Drive. A taper adaptor is provided to enable the Drive to be fitted to either $^3/_4$ in (19 mm) or 1 in (25 mm) steering shaft tapers. As the way in which components are fitted depends on the diameter of the steering shaft, you need to ascertain the diameter of the steering shaft before you fit the Drive.

Step 1 – Remove the steering wheel

CAUTION: Turn the wheel fully clockwise

Before you remove the steering wheel, it is very important to turn it fully clockwise, otherwise damage to the Drive could occur in the later stages of installation.

1. Turn the wheel fully clockwise to starboard lock.
2. Remove the steering wheel hub cover.
3. Holding the steering wheel at full starboard lock, use the supplied box spanner or a suitable socket to remove and retain the wheel securing nut and washer.
4. Carefully remove the steering wheel (a bearing puller will assist with this).
5. Remove and retain the woodruff key.

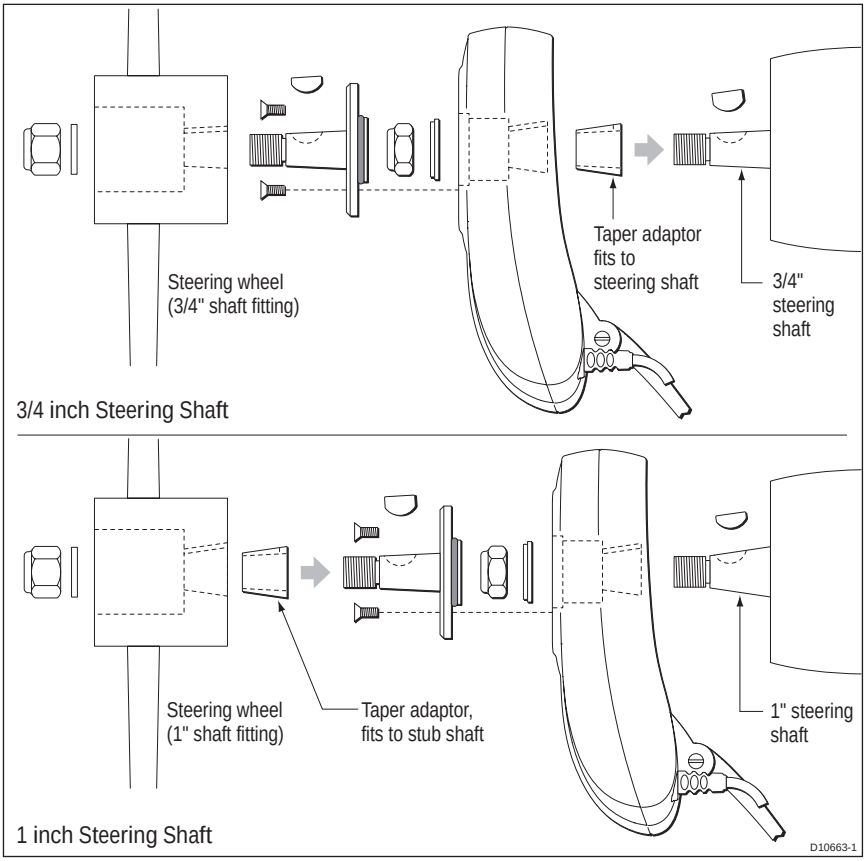


Step 2 - Check wheel shaft size

As the way in which components are fitted depends on the diameter of the steering shaft, it is very important to ascertain the steering shaft diameter before you proceed with the fitting procedure.

As a rough guide, if you can slide the taper adaptor supplied with your SPX-5R Drive onto the taper of the steering shaft, then the steering shaft is 3/4 inch diameter. If the taper adaptor is too small to fit onto the steering shaft, then the steering shaft is 1 inch diameter.

The following simplified diagrams show the general arrangement of the major components for each size of steering shaft.



Step 3 - Plan suitable mounting angle

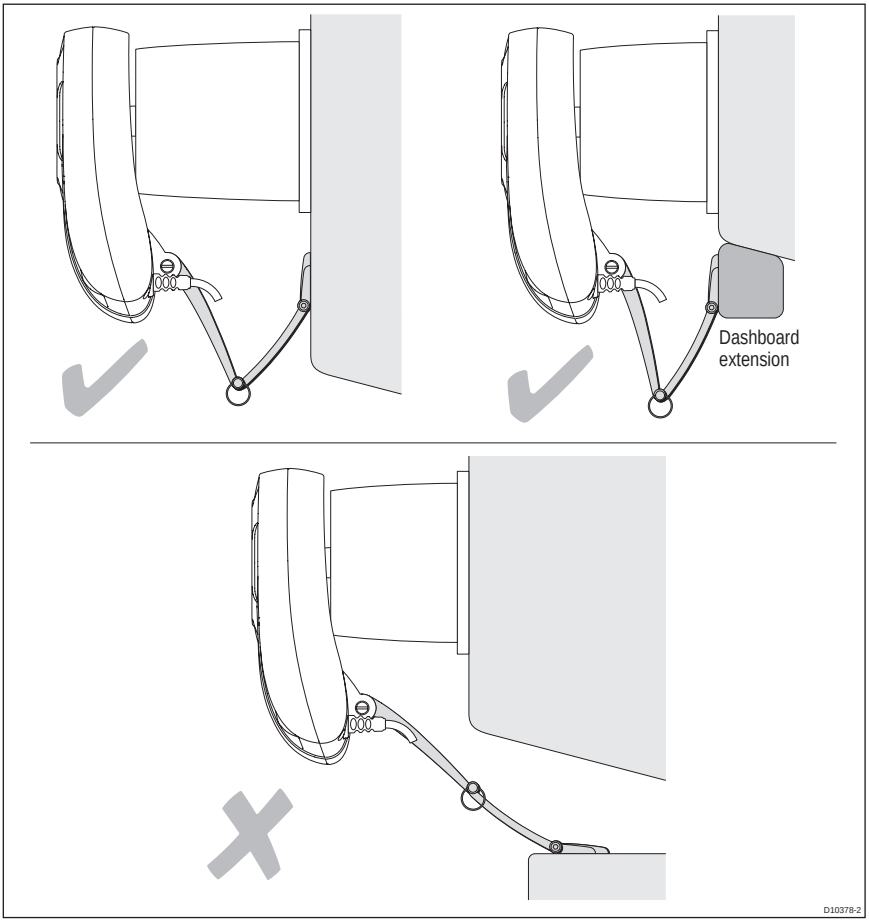
The Drive unit MUST be mounted at an angle of no more than 35° from vertical, to ensure adequate drainage of water for all rotating parts. You MUST also ensure that the drain hole at the base of the unit is kept clear at all times.

Step 4– Prepare to fit torque restraint

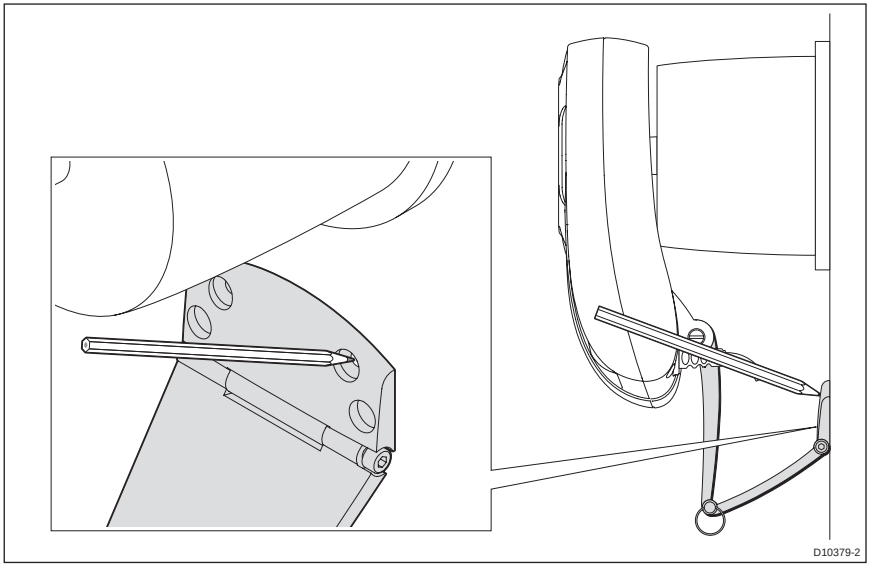
1. If the steering wheel shaft is 1 inch diameter, proceed from step 2 below. If the shaft is $^3/_4$ inch diameter, slide the taper adaptor (supplied) fully onto the steering wheel shaft taper, with the keyways are aligned.
2. Temporarily place the SPX-5R Drive onto the steering shaft, with the torque restraint at the lowermost point.

3. Referring to the following illustration, identify a convenient surface that will provide a secure anchoring point for the torque restraint bracket.

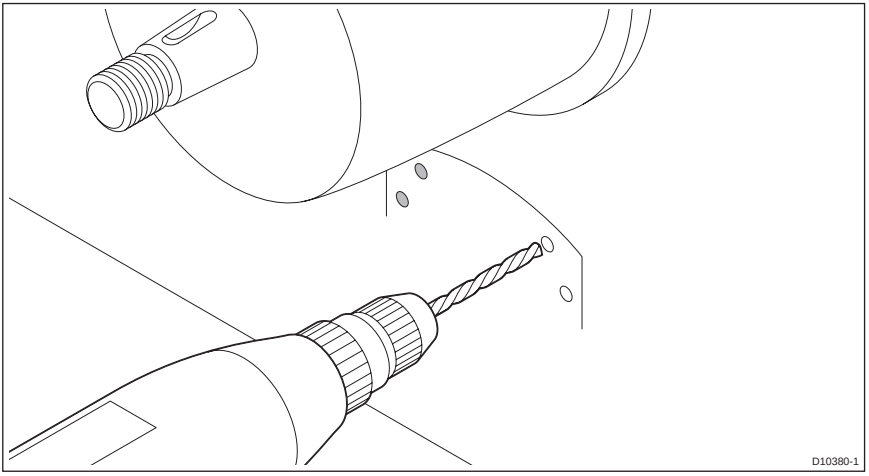
Note: *If your dashboard does not extend below the bottom of the SPX-5R Drive, you may need to manufacture an extension from a suitable material, and permanently attach it to the dashboard, to accommodate the torque restraint bracket.*



4. Offer up the torque restraint bracket to the mounting surface and mark the positions for the securing screws.



5. Remove the SPX-5R Drive from the steering shaft, then drill four $^{5}/_{32}$ in (4 mm) holes for the securing screws.



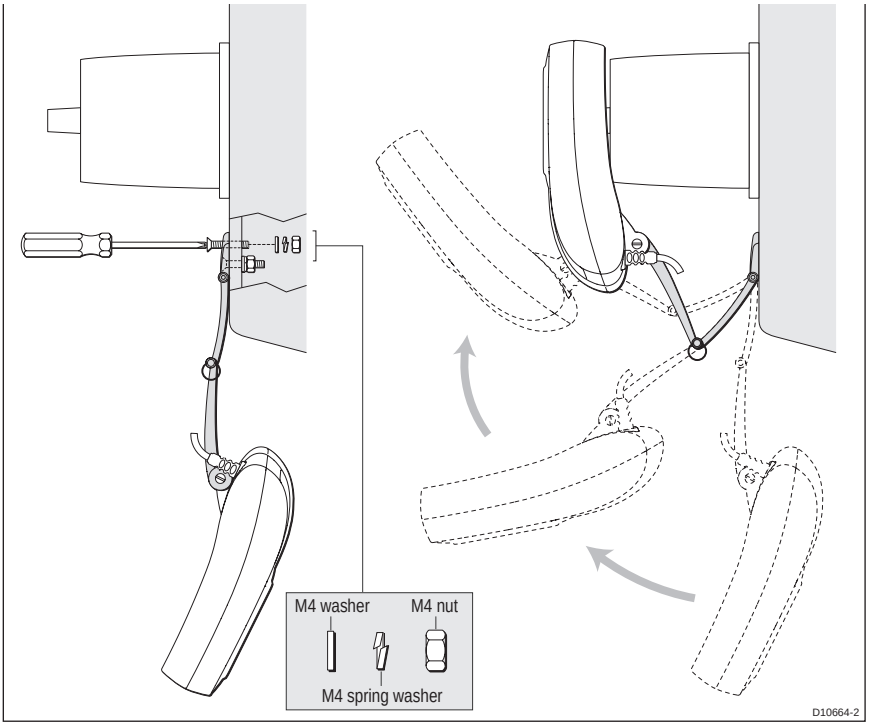
Step 5- Fit Drive unit

CAUTION: Ensure correct mounting angle

The Drive unit MUST be mounted at an angle of no more than 35° from vertical, to ensure adequate drainage of water for all rotating parts. You MUST also ensure that the drain hole at the base of the unit is kept clear at all times.

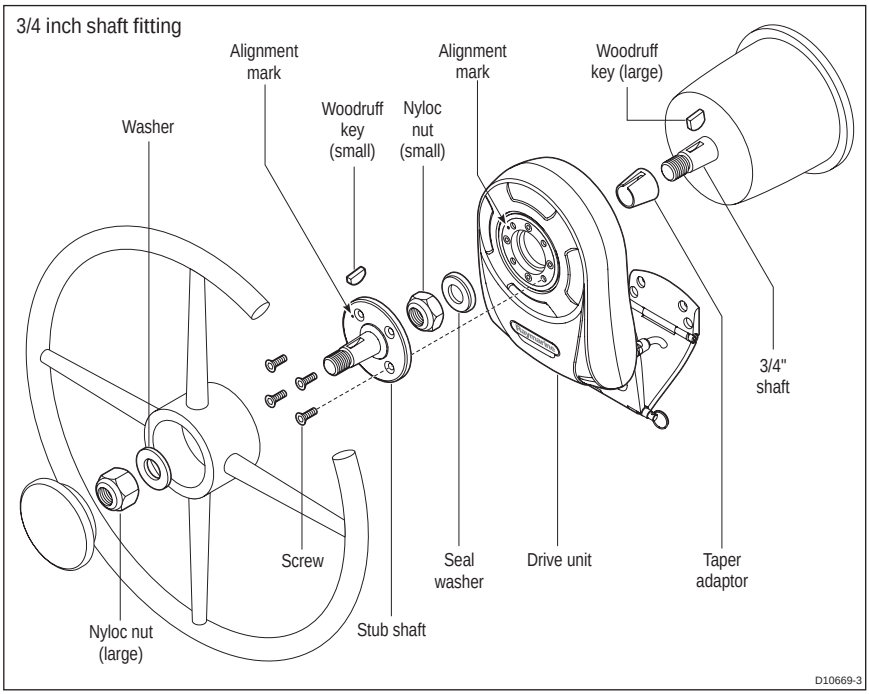
Introduction

1. Secure the torque restraint to the mounting surface, using the four M4 screws, nuts and washers provided, as shown in the following illustration.



2. Fit the SPX-5R Drive in accordance with the instructions for either a $^{3}/_{4}$ inch or 1 inch steering shaft, as appropriate (see below).

Fitting to 3/4 inch steering shaft



To fit the SPX-5R Drive to a $^3/_4$ inch steering shaft, refer to the illustration above and:

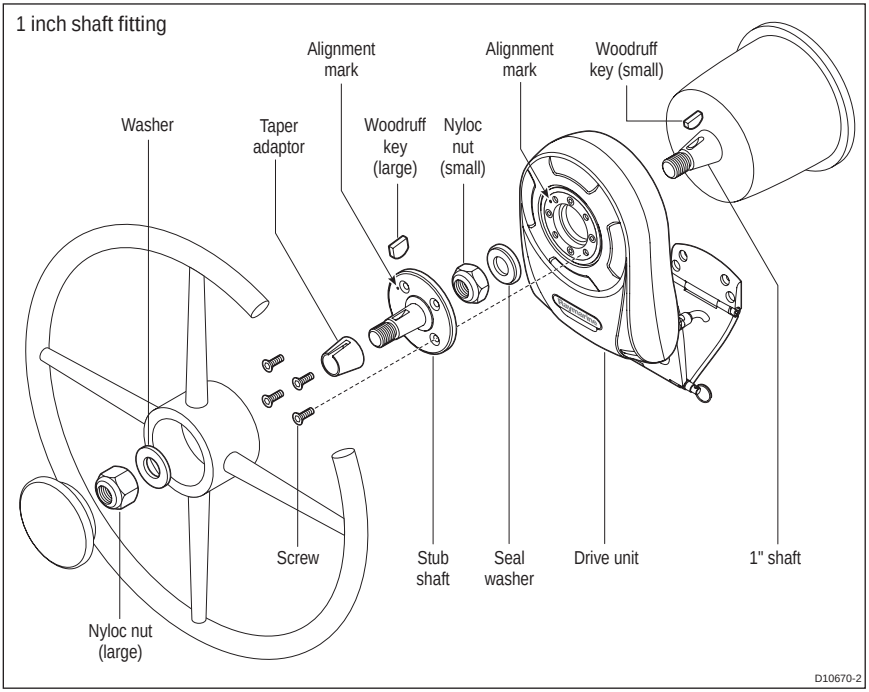
1. Ensure that the taper adaptor, is correctly aligned and in place on the steering shaft.
2. Insert the larger of the two woodruff keys supplied into the drive shaft keyway. If necessary, use a small hammer to lightly tap the key into position.
3. Slide the SPX-5R Drive onto the shaft so that the woodruff key inserted at step 2 engages with the keyway in the drive.

Note: *You **MUST USE** the nyloc nut supplied with the Drive to secure the drive assembly to the shaft. Place the $^5/_8$ inch seal washer (supplied) on the shaft so that the seal side is towards the Drive.*

4. Use the supplied box spanner to secure the drive unit with the $^5/_8$ inch nylock nut supplied.
5. With the steering still hard over to starboard, tighten the drive unit securing nut to 22 pound feet (30 Newton meters).
6. Offer up the stub shaft to the drive unit, ensuring the alignment marks on the stub shaft and drive unit are aligned. Secure the stub shaft to the drive with the four countersunk screws supplied. Tighten each screw to 20 pound inches (2.26 Newton metres).
7. Insert the smaller of the two woodruff keys supplied into the keyway on the stub shaft. If necessary, use a small hammer to lightly tap the key into position.

8. Slide the steering wheel onto the stub shaft, so that the woodruff key inserted at step 8 engages with the keyway in the wheel.
9. Place the original steering wheel washer on the shaft then secure the steering wheel with the original wheel-securing nut.
10. Replace the wheel hub cover.

Fitting to 1 inch steering shaft



To fit the Drive Pilot drive to a 1 inch steering shaft, refer to the illustration above and:

1. Insert the smaller of the two woodruff keys supplied into the keyway on the steering shaft. If necessary, use a small hammer to lightly tap the key into position
2. Slide the SPX-5R Drive onto the steering shaft so that the woodruff key inserted at step 1 engages with the keyway in the drive.

Note: *You **MUST USE** the nyloc nut supplied with the Drive to secure the drive assembly to the shaft.*

3. Place the $^{5}/_{8}$ inch seal washer (supplied) on the shaft so that the seal side is towards the Drive.
4. Use the supplied box spanner to secure the drive unit with the $^{5}/_{8}$ inch nylock nut supplied.
5. With the steering still hard over to starboard, tighten the drive unit securing nut to 22 pound feet (30 Newton metres).
6. Offer up the stub shaft to the drive unit, ensuring the alignment marks on the stub shaft and drive unit are aligned. Secure the stub shaft to the drive with the four

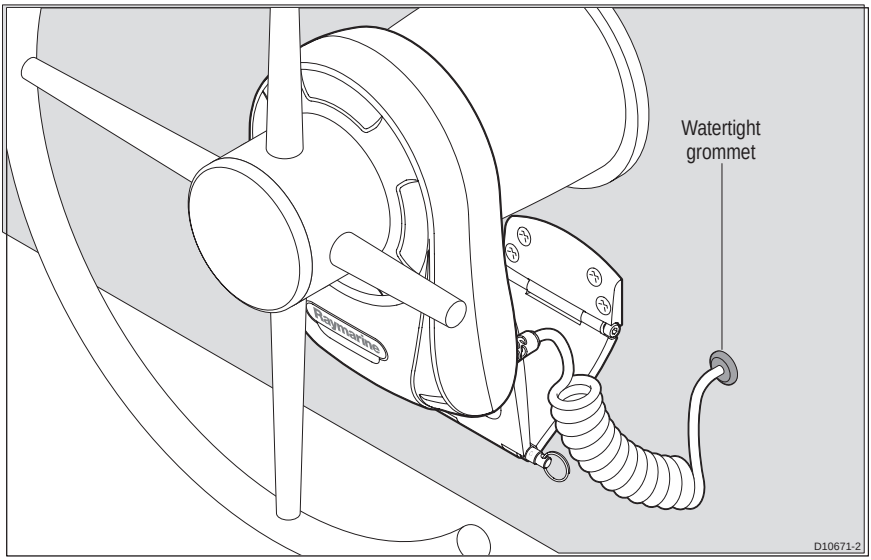
countersunk screws supplied. Tighten each screw to 20 pound inches (2.26 Newton metres).

7. Ensuring that the keyways are aligned, slide the taper adaptor (supplied) onto the stub shaft, as far as it will go.
8. Insert the larger of the woodruff keys supplied into the keyway on the stub shaft. If necessary, use a small hammer to lightly tap the key into position
9. Slide the steering wheel onto the stub shaft, so that the woodruff key inserted at step 8 engages with the keyway in the wheel.
10. Place the original steering wheel washer on the stub shaft, then secure the wheel with the original wheel-securing nut.
11. Replace the wheel hub cover.

Drive cable routing

We recommend that the entry point for the cable from the SPX-5R Drive is positioned so that the chances of water entering through the cable entry point are minimized. A watertight grommet is supplied, but if this is not suitable for the thickness of the surface through which you intend routing the cable, obtain another grommet of suitable size, then:

1. In a suitable location drill a hole for the cable grommet.
2. Remove any rough edges from the hole then fit the grommet.
3. Feed the free end of the cable through the grommet, leaving the coiled part of the cable outside.



2.5 Connecting power & drive cables to the Course Computer

Power

The SPX-5R Drive system needs a 12 V dc supply.

CAUTION: Ensure correct supply voltage
Do NOT connect 24 V to the Course Computer, or damage to the product could occur.

Circuit breaker/fuse

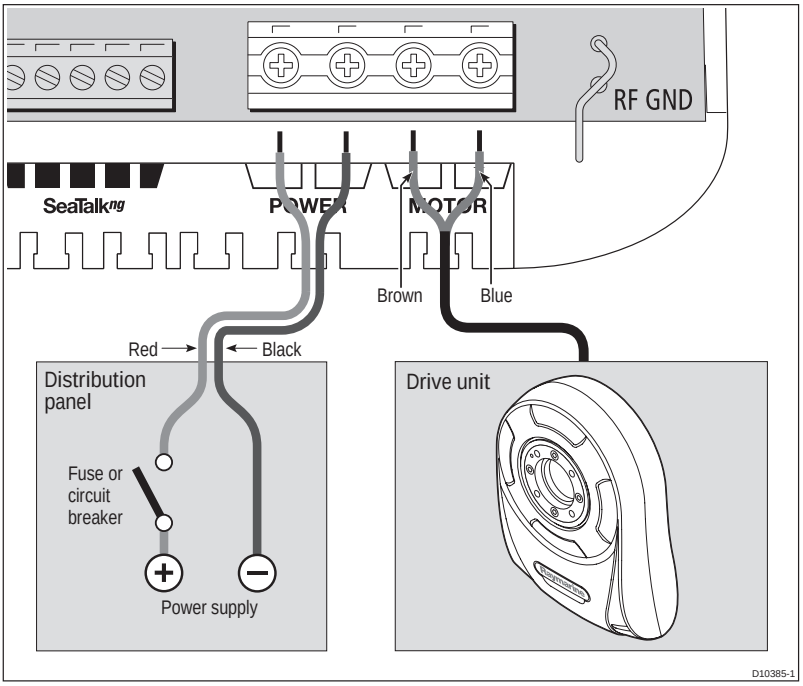
At the power distribution panel, protect the power supply for the SPX-5R Drive system with a 20 A fuse or 15 A thermal circuit breaker.

Cable

Using the information given at *Power cable requirement* on *page 8 & 9*, obtain the required length of the appropriate cable to connect power from the boat's distribution panel to the Course Computer.

Note: *The power cable attached to the drive unit MUST be left intact. Coil and tie any excess, do NOT cut or otherwise remove it.*

Connection procedure



At the Course Computer, locate the free ends of the cables from the distribution panel and Drive. Ensuring all power is switched off, refer to the illustration above and connect each cable to the correct Course Computer terminals as follows:

1. Strip 8-10 mm (3/4 inch) of insulation from the end of each wire.
2. Use a small screwdriver to loosen the relevant screws on the terminal block.
3. Insert the stripped wires into the appropriate terminals then tighten the terminal block screws.

2.6 Fluxgate Compass

Note: *If you intend using a separate NMEA compass, do not connect the Fluxgate Compass supplied with your SPX-5R Drive system. Instead, connect the NMEA compass to the NMEA input on the SPX-5R system.*

Use these instructions to install the Fluxgate Compass. After fitting the Fluxgate Compass, ensure you affix the compass safe area label adjacent to the Fluxgate Compass.

The compass contains a self-levelling mechanism. This enables the compass to provide accurate readings with pitch and roll movements up to +/- 35°.

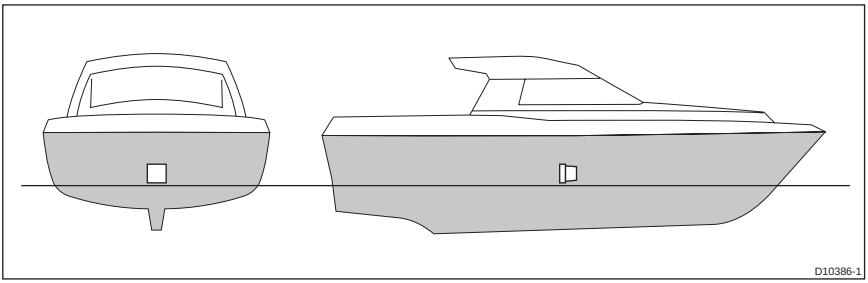
Note: *When shaken, the Fluxgate Compass makes a rattling sound. This is entirely normal and is not a cause for concern.*

Compass mounting

Location

To achieve the best performance, mount your compass:

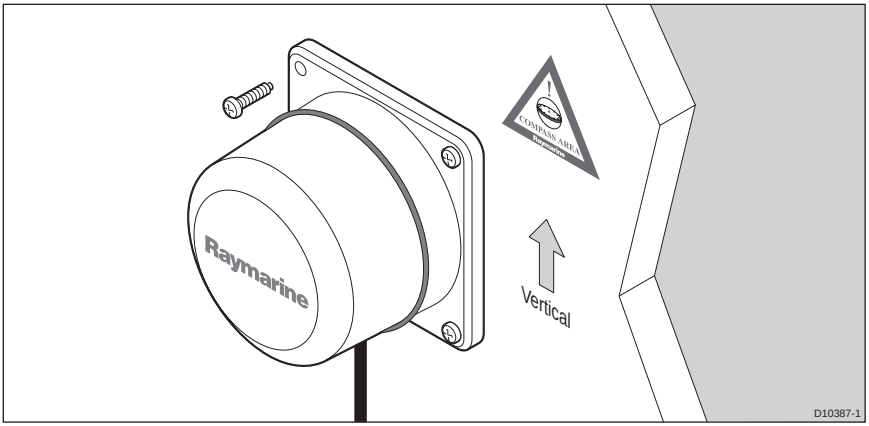
- With the Raymarine logo facing the bow.
- As close as possible to the boat's pitch and roll center.
- At least 2ft 6 in (0.8 m) away from your boat's steering compass to avoid deviation of both compasses.
- As far away as possible from other cables and large iron masses, such as the engine or other magnetic devices.



Note: *To check if the intended mounting location is free from magnetic influence, tape a handheld compass to the chosen location, then turn the boat through 360°. The readings on the handheld compass and your boat's main steering compass (if accurately aligned) should not differ by more than10° at any heading.*

Mounting procedure

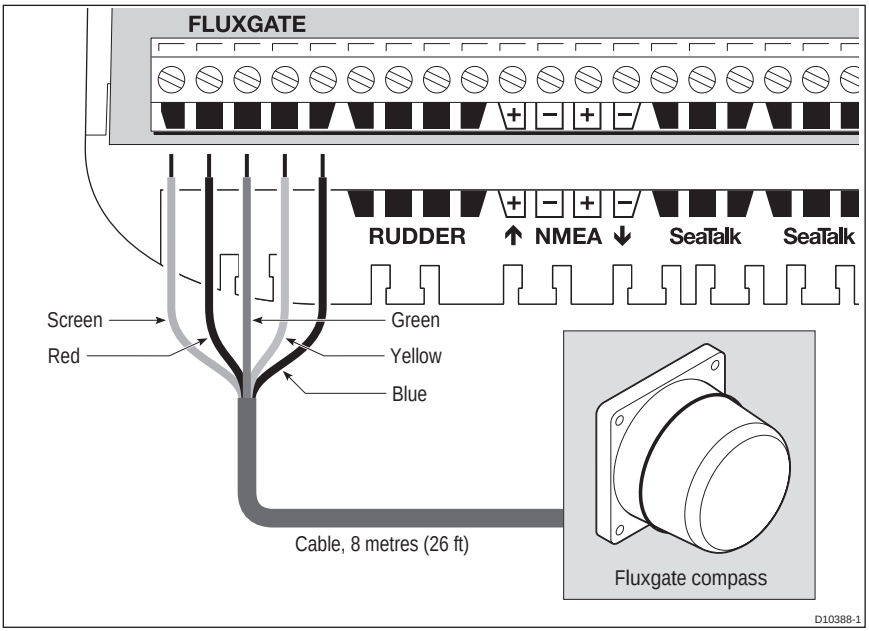
1. Mount the Fluxgate Compass on a vertical bulkhead, with the cable leaving at the bottom of the unit.
2. Stick the supplied warning label near to the compass, where it is clearly visible.



Compass connection

Route the compass cable to the Course Computer, securing it at regular intervals with suitable cable clips/ties.

Connect to the Course Computer as in the following illustration.



2.7 Pilot Controller

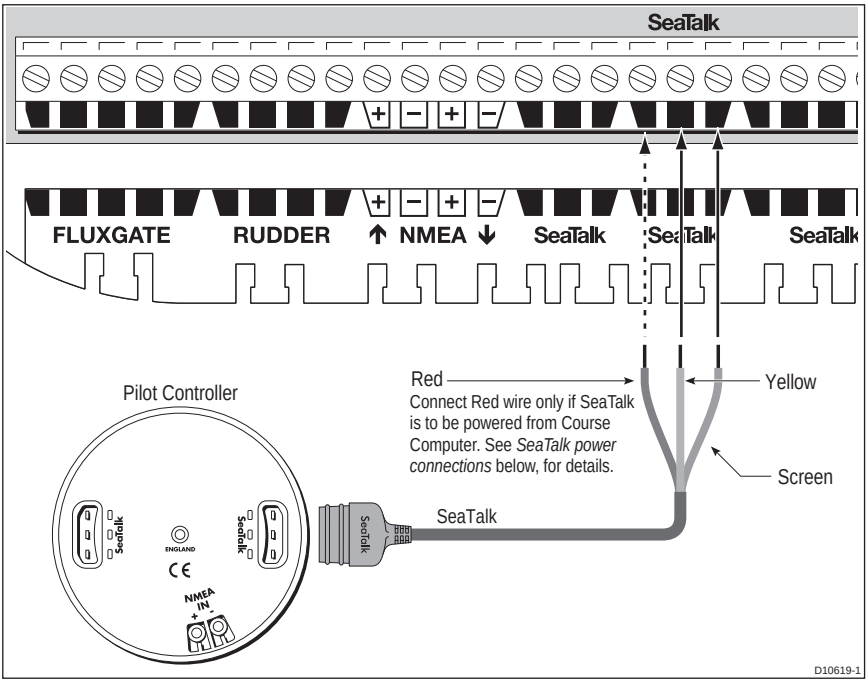
Fitting

The ST6002 Pilot Controller is supplied with an 4 m cable for connection to the SeaTalk bus. Ensure that your mounting location is within 4 m of a suitable connection point. You may purchase a longer cable if required.

Fit the controller in accordance with the separate instruction leaflet.

Connect controller and SeaTalk bus

The Pilot Controller connects to SeaTalk at the Course Computer, as shown in following diagram.

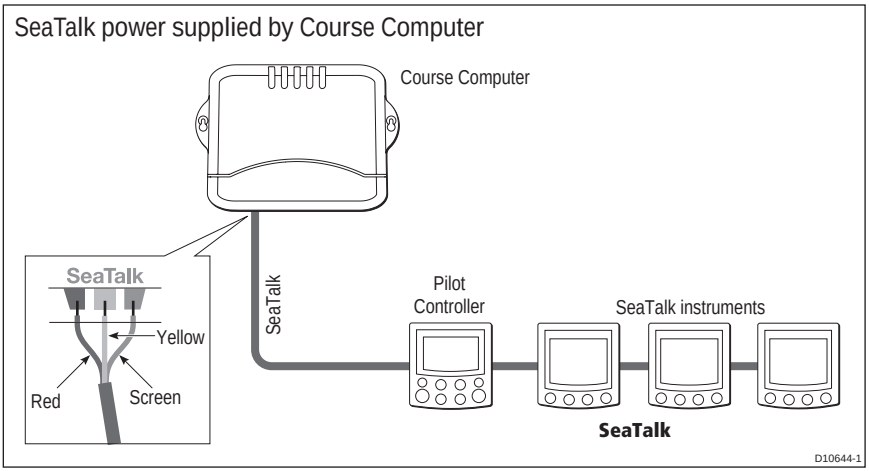


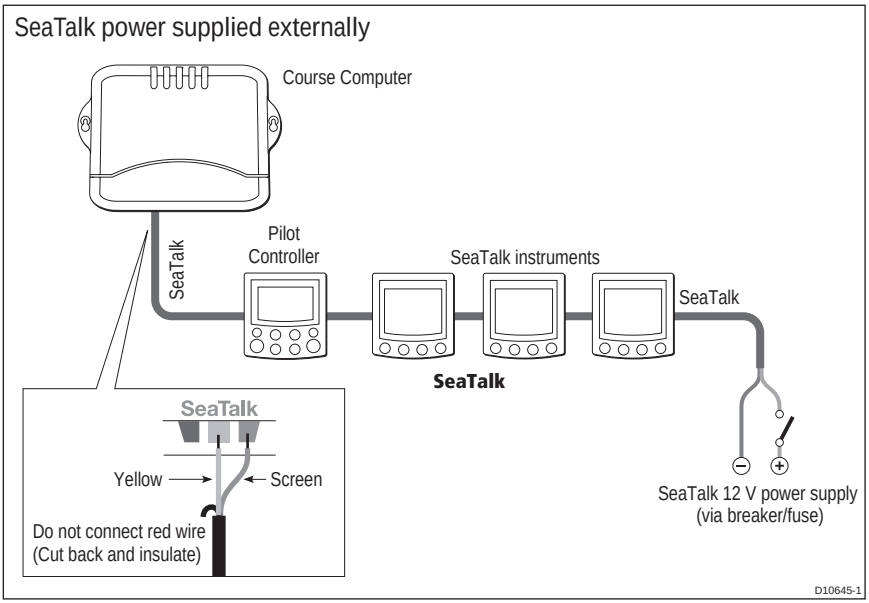
Note: *You will need an additional cable to connect your controller to an existing SeaTalk instrument.*

SeaTalk power connections

The exact manner in which connections are made depends on how power is supplied to SeaTalk:

- If power is supplied by the Course Computer, connect the red and yellow wires and the screen to the Course Computer.
- If power is supplied from an external source, connect only the yellow wire and the screen to the Course Computer. Do NOT connect the red wire.


SeaTalk power supplied by Course Computer
Course Computer
SeaTalk
Yellow
Red
Screen
SeaTalk
Pilot
Controller
SeaTalk instruments
SeaTalk
D10644-1


SeaTalk power supplied externally
Course Computer
SeaTalk
Pilot
Controller
SeaTalk instruments
SeaTalk
SeaTalk
SeaTalk
Yellow
Screen
Do not connect red wire
(Cut back and insulate)
SeaTalk 12 V power supply
(via breaker/fuse)
D10645-1

2.8 Connect to ground

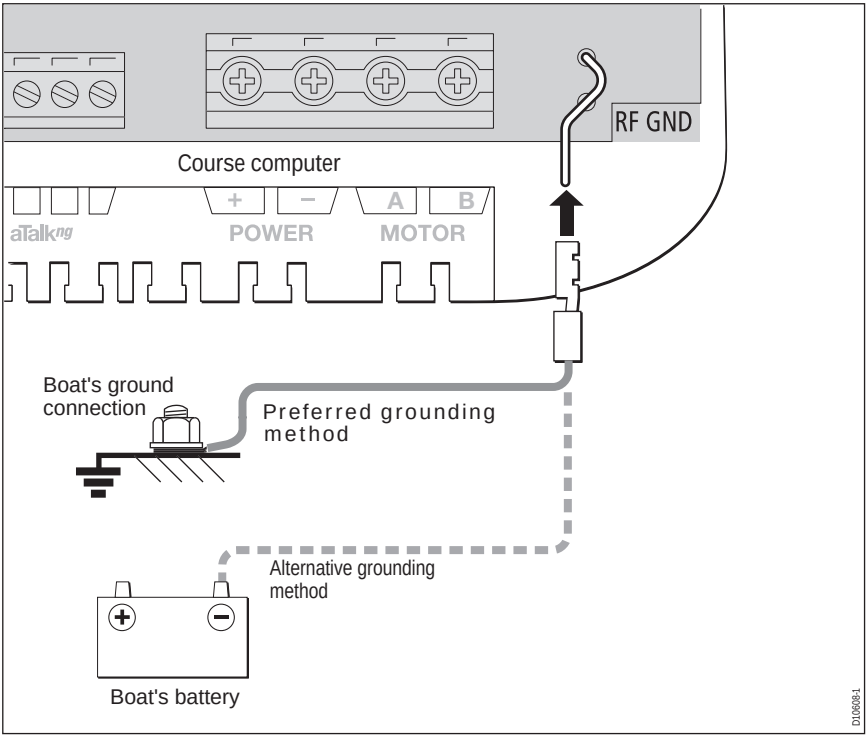
CAUTION: Grounding

The SPX-5R Drive system ground MUST be connected to ship's ground. Failure to connect to ship's ground may cause it, or other on-board electronics to malfunction.

To ground your SPX-5R Drive system:

- Use a dedicated earthing plate (e.g. dynaplate) in contact with the water.
- Use flat tinned copper braid, 30 A rating $^1/_4$ inch (6.5 mm) or greater. Equivalent stranded wire diameter $^3/_{16}$ inch (4 mm) or greater
- Keep the length of the earth braid as short as possible.

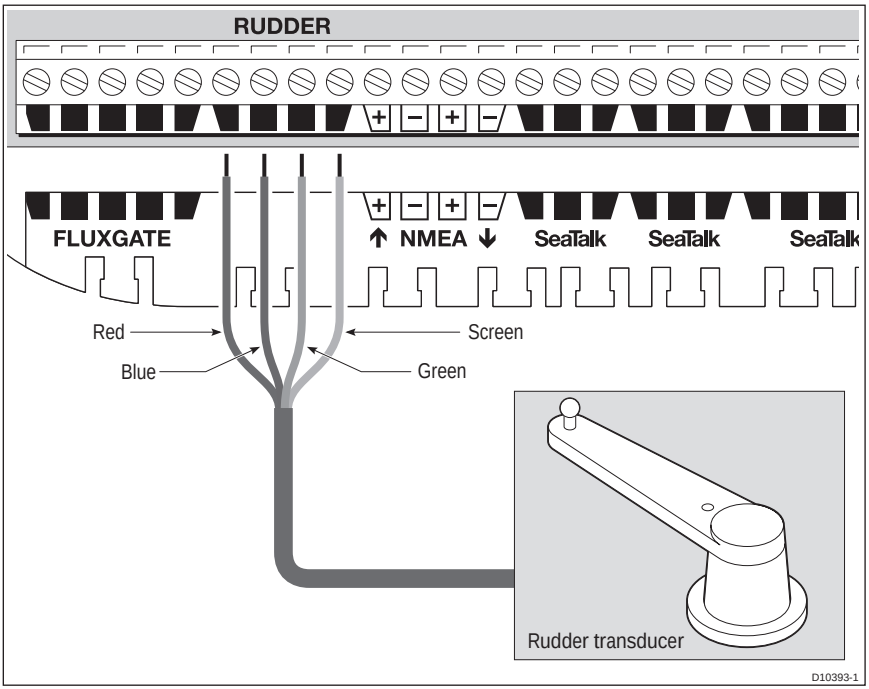
Note: *If you cannot connect to a dedicated earthing plate you may connect ground to the negative terminal of the battery (ideally at the battery itself).*



2.9 Optional connections

Rudder reference

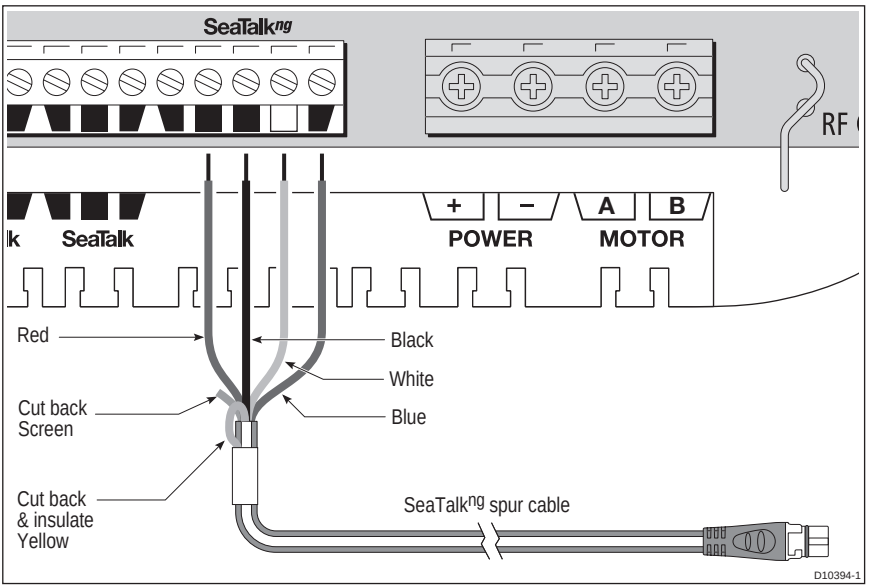
For suitable vessels, an optional rudder reference transducer is available to provide an accurate display of the rudder angle, and further improve steering accuracy and performance of the SPX-5R Drive system. If you have the optional rudder reference transducer, connect it to the course computer as shown.



SeaTalkng Connections

To connect your autopilot to a SeaTalkng backbone, use a dedicated spur cable. Spur cables are available from your Raymarine dealer, as follows:

SeaTalkng spur cable length	Part number
1 ft 3 in (400 mm)	A06038,
3 ft 3 in (1 m)	A06039
9 ft 10 in (3 m)	A06040
16 ft 4 in (5 m)	A06041



SeaTalkng power

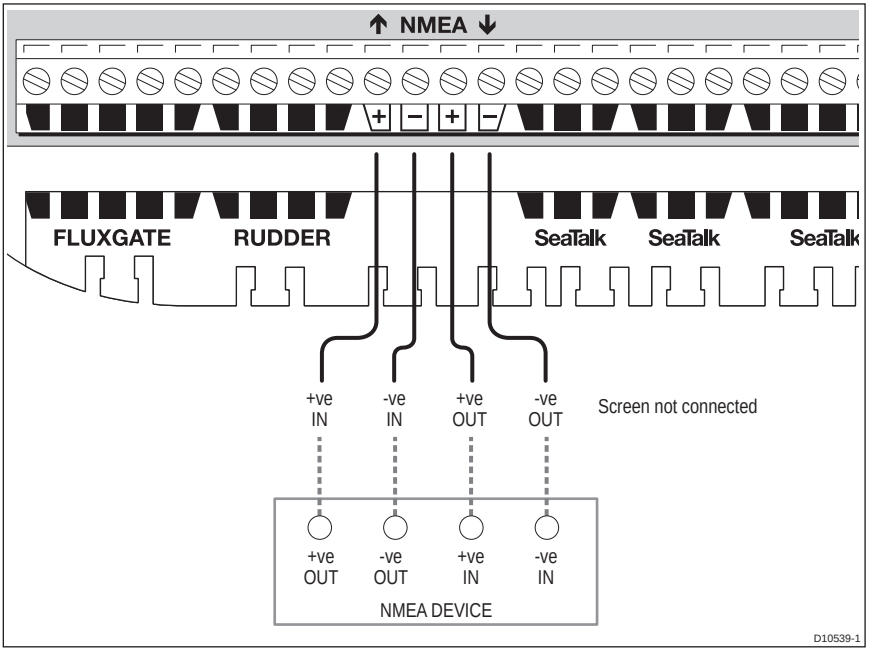
The Course Computer does NOT supply power for SeaTalkng. A SeaTalkng system must be powered from its own separate power supply.

See also

For more information on SeaTalkng systems refer to the separate reference guide available from the Raymarine web site. www.raymarine.com/handbooks.

NMEA 0183 equipment

The SPX-5R Drive system can connect via an NMEA port to NMEA devices such as a GPS or chartplotter.



Data bridging

The SPX-5R Pilot system acts as a bridge between SeaTalk and NMEA0183, allowing NMEA and SeaTalk devices to share information.

For example, the information received from an NMEA GPS could be shared with a SeaTalk instrument to provide a separate Course Over Ground display.

NMEA 0183 / Connecting other manufacturers' equipment

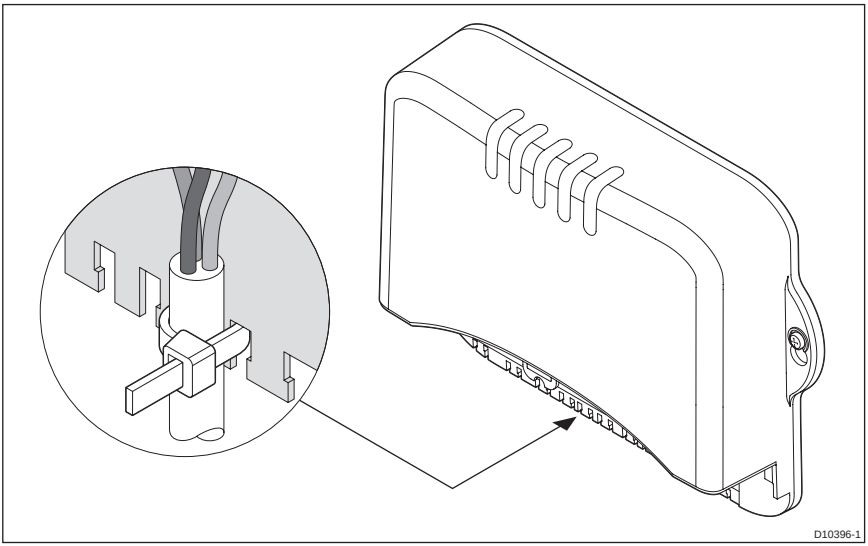
- When connecting Raymarine equipment to other equipment using a non-Raymarine cable, you MUST attach an appropriate suppression ferrite to the cable near to the Raymarine unit.
- When connecting third party equipment refer to the manufacturer's instructions for cable details.
- You should not connect more than one piece of equipment to the Course Computer NMEA input.

2.10Final checks

When you have completed all necessary installation procedures, but before you apply power to the system, ensure all equipment and connections are properly secured.

Secure all cables

To prevent strain on the connector blocks, secure the cables to the Course Computer with cable ties as shown below.



2.11Commission the system before use

The autopilot must be commissioned prior to use. For new systems this involves calibrating the system, which is a **safety-critical action**.

Refer to *Section Chapter 3:, Commissioning & Setup* for instructions.

Chapter 3: Commissioning & Setup

This chapter describes the commissioning and setup procedures for your Raymarine SPX-5R Drive system.

Requirement

The commissioning procedures are mandatory and must be carried out after installation, before the SPX-5R Drive system is used to steer the boat. The commissioning procedures comprise a series of dockside checks and setup procedures followed by a short seatrial.

Additional setup procedures are also provided for you to fine tune your SPX-5R Drive system for optimum performance with your boat. They are not mandatory and you may find that you do not need to use them if the SPX-5R Drive system operates to your satisfaction after commissioning.

When commissioning and setting up the SPX-5R Drive system, use the supplied ST6002 controller (Pilot Controller):

- standby & auto select the required operating mode.
- +1, -1, +10 & -10 initiate course changes.
- disp & track provide access to extended functions.

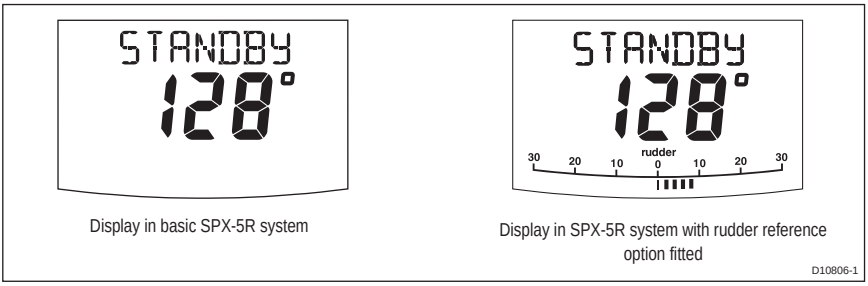
Note: *The system is also compatible with ST7002, ST8002, S100, SmartController and ST70 Pilot Controllers.*

Power assisted steering

If your vessel has power steering, this must be operating before commissioning or using the autopilot. Operating the autopilot without the power assist steering in operation could cause damage to the Drive.

Rudder reference information

The basic SPX-5R Drive system is supplied without a rudder reference transducer, so in the basic system, the Pilot Controller display does not show a rudder reference bar or indicator. However, the SPX-5R Drive system is compatible with the Raymarine rudder reference transducer, and this can be fitted as an option.



Display in basic SPX-5R system

Display in SPX-5R system with rudder reference option fitted

D10806-1

3.1 Commissioning

The commissioning process comprises:
- Dockside checks & setup.
- Seatrial calibration.

Dockside checks & setup

The dockside checks comprise:
1. Switching on.
2. Checking SeaTalk and NMEA 0183 connections.
3. Checking rudder bar and steering operating sense.
4. Dealer calibration settings. These are:
   - Checking autopilot steering sense.
   - Setting vessel type and drive type.
   - Setting rudder limits, if rudder reference option fitted.

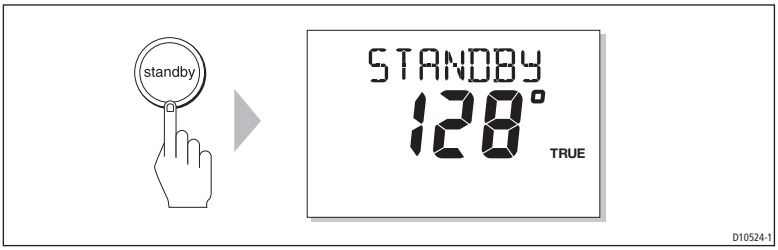
WARNING:
For safe control of your boat, you MUST complete the dockside preparation before starting the initial seatrial.

With the boat safely tied up, carry out the dockside checks and setup procedures before any trials at sea or other setup procedures.

Step 1 - Switching on

1. Observing the Drive unit, switch on the main power breaker. If the Drive moves, switch off the power immediately, then ensure the system wiring is correct before proceeding.
2. When the Pilot Controller and Course Computer are powered up, the controller will beep and show the controller type for a few seconds, before showing the **STANDBY** screen.
   You may also see a **CALIBRATE REQUIRED** message. This is displayed for a short time if either
   - The vessel type is not selected.
   - The compass is not calibrated.

   These will be calibrated during commissioning.
3. Check that the **STANDBY** screen displays a live compass heading.



Startup problems

- If the Pilot Controller does not beep or the display is blank, switch off the power, then check the fuse/circuit breaker and the SeaTalk fuse in the SPX Course Computer.
- If the display shows the **SEATALK FAIL** or **NO PILOT** alarm message, check the SeaTalk connections.
- If the **STANDBY** screen does not display a live compass heading, check the sensor connections.

Step 2 - Check data connections

Pilot controller

Check the SmartPilot controller links as follows:

- With on the Pilot Controller switched on, check that the Pilot Controller display shows **STANDBY**.
- If this does not happen or if the display shows **NO PILOT,** check the cabling and connections between the Pilot Controller and the other units.

SeaTalk and NMEA GPS or Chartplotter

If you have connected the SPX-5R Drive system to a chartplotter or GPS (e.g. via NMEA or SeaTalk), check the links by displaying the default navigation data pages on the Pilot Controller:

1. Press **disp** to display the first data page (XTE), and check that this page shows the expected data.
2. Press **disp** again to check each successive data page (**BTW, DTW** etc)

If the display shows dashes instead of data values, ensure:

- The GPS or chartplotter is switched on and transmitting active waypoints.
- The GPS or chartplotter is configured to transmit the required data format.
- There is not a cabling error. Check for open circuit, short circuit or reversed connections.

Other NMEA connections

To check other NMEA connections, you will need to set up the appropriate page of data using Dealer calibration mode.

Data pages are viewed by pressing the **disp** key (when in Standby or Auto mode).

For details of supported NMEA sentences, see *Appendix 1: NMEA 0183 sentences*

Step 3 - Checking rudder bar operating sense

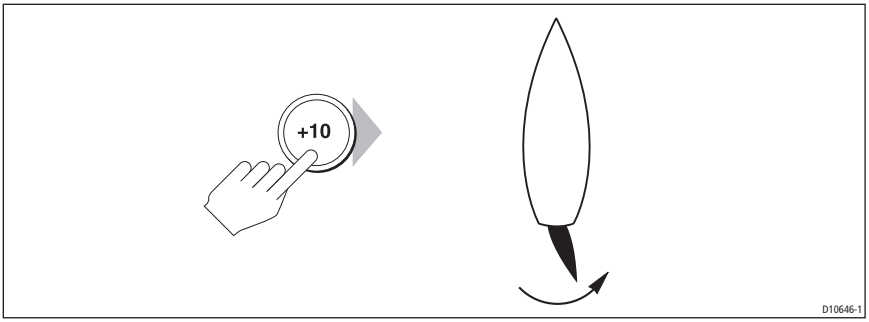
If a rudder reference transducer is fitted, check the rudder bar operating sense as follows:

1. Turn the wheel manually to starboard.
2. Check that the rudder bar on the controller display moves to starboard.
   If the rudder bar moves the wrong way:
   i. Turn off the power.
   ii. Reverse the red and green wires connected to the RUDDER inputs on the SPX Course Computer.
   iii. Switch on the power and re-check.

Step 4 - Checking steering operating sense

Check the steering operating sense as follows:

1. Manually center the wheel, then press **auto** (so the SPX-5R Drive system is in Auto mode)
2. Check that the display shows **AUTO**.
   Be ready to press standby if the rudder moves hardover.
3. Press +10 once.



4. Check that the rudder moves to starboard a few degrees and then stops.
   if the rudder drives hard over, immediately press **standby** to prevent further rudder movement.
5. If the rudder moves to port or the rudder drives hard over:
   i. Press **standby.**
   ii. Turn off the power.
   iii. Reverse the motor wires connected to the SPX-5R Drive system computer.
   iv. Switch on the power and re-check.

Note: *If the rudder overshoots and has to drive back or starts to hunt back and forth, you will need to increase the rudder damping level manually (See page 57).*

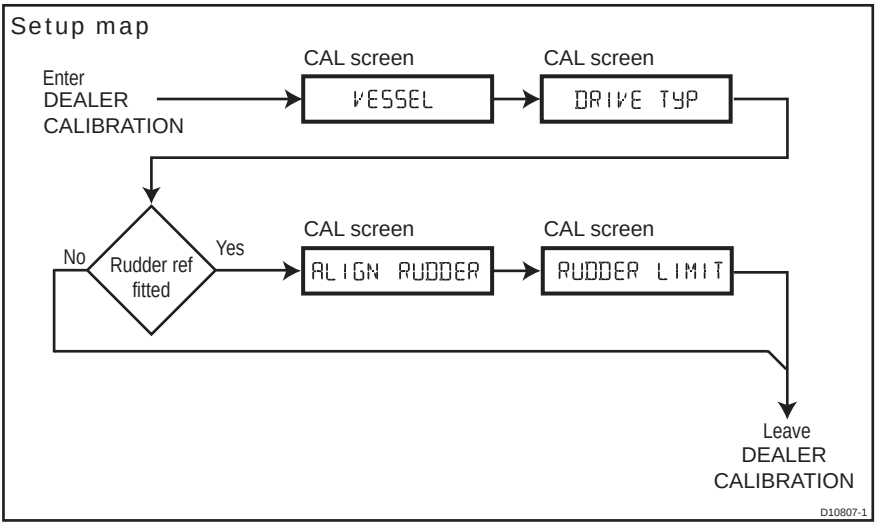
Step 4 - Dealer calibration settings

Introduction

WARNING: Use Dealer calibration correctly

Improper use of Dealer calibration can seriously impair the SPX-5 Drive system performance and therefore adversely affect the steering capability. Do not change Dealer calibration settings other than as described in the product documentation.

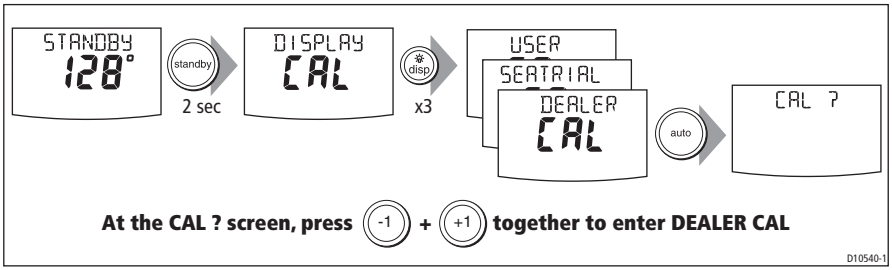
To proceed with the dockside preparation, you need to carry out certain Dealer calibration setup functions. The exact requirement and consequently the calibration screens displayed, depend on whether a rudder reference transducer is fitted, as summarized in the following diagram.



Entering Dealer calibration

Enter Dealer calibration as follows:

1. Ensure the SPX-5R Drive system is in Standby mode.
2. Hold down standby for two seconds to enter the Calibration mode.



3. When the screen shows **DISPLAY CAL**, press disp until the **DEALER CAL** screen is displayed.
4. Press auto. The display will change to **CAL**.
5. Press **-1** and **+1** together to enter Dealer calibration.
6. In Dealer calibration, access the vessel type screen, using disp if necessary. The vessel type screen shows either **VESSEL** or one of the vessel types (**DISPLACE, SEMI DISPLACE, PLANING, STERN DRV, WORK BOAT or SAIL BOAT**).

Setting the vessel type

The vessel type setting automatically determines appropriate default values for various other calibration settings. Some of these settings are checked later in this procedure and others should not require any adjustment. The default values for each vessel type are listed on *page 60*.

Set the vessel type as follows:

1. Use -1 or +1 to select the appropriate type of boat:

Options	Notes
DISPLACE	Power driven boats which do not plane. (Typically below 15 kts top speed)
SEMI DISPLACE	Faster power-driven boats which do not plane
PLANING	Planing boats with inboard engine(s) and shaft drives (NOT boats with outdrives or outboard engines)
STERN DRV	Boats with outdrives or outboard engines
WORK BOAT	Commercial tugs, fishing vessels etc
SAIL BOAT	Not applicable for SPX-5R Drive.

2. Press disp to confirm the selection and move to the drive type option.

Setting the drive type

With the **DRIVE TYP** screen displayed, set the drive type as follows:

1. Use -1 or +1 to select drive type **3**.
2. Press disp to confirm the selection and move to the next calibration option.

Align the rudder indicator

If a rudder reference transducer is fitted, the **ALIGN RUDDER** page is displayed. If this is the case, align the rudder indicator as follows:

1. Use the wheel to enter the rudder.
2. Use -1 and +1 to adjust the rudder bar so it is positioned at the center of the rudder bar on the Pilot Controller display.
   The maximum adjustment available is ±9°. If the offset is beyond these limits, you will need to physically adjust the alignment of the sensor.
3. Press disp to confirm the correct alignment and move to the next calibration option. See the *Setup map* above.

Note: *You can also zero the rudder bar with the boat under way during the initial Seatrial (see page 40.*

Set the rudder limits

If a rudder reference transducer is fitted, the **RUDDER LIMIT** page is displayed. If this is the case, set the rudder limits as follows:

1. Turn the wheel to move the rudder:
   - To the port end stop and note the angle on the rudder bar
   - To the starboard end stop and note the angle on the rudder bar
2. Use -1, +1, -10 and +10 to set the rudder limit to 5° less than the lowest angle you have noted.

Save the new settings

When you have adjusted the above settings, hold down standby for two seconds, to save your changes, leave Dealer calibration and return to the Standby mode.

Seatrial calibration

When you have completed the dockside checks, carry out a Seatrial calibration, to calibrate the compass and set up the autopilot steering characteristics.

Important

If you need to return to manual steering at any time during a Seatrial or any other procedure, **press the standby button**. NEVER compromise vessel safety.

EMC conformance

Always check the installation before going to sea to make sure that it is not affected by radio transmissions, engine starting etc.This is particularly important when carrying out a Seatrial.

Seatrial conditions

The seatrial must be carried out only:

- In conditions of light wind and calm water.
- In waters that are clear of any obstructions, so the boat has plenty of clear space to maneuver.

In order to achieve optimum autopilot performance, course over ground (COG), speed over ground (SOG) and latitude (LAT) data must be available to the SPX-5R Drive system (e.g. on SeaTalk). Ensure that the equipment providing this information (e.g. GPS), is switched on and fully operational, before starting a Seatrial.

The Seatrial procedures are:

- Compass calibration.
- Using AutoLearn to set the SPX-5R Drive system steering characteristics.

Getting started

Start the SeaTrial calibration as follows:

1. From Standby mode, hold down standby for 2 seconds, then press disp twice to see the **SEATRIAL CAL** screen.
2. Carry out the Seatrial calibration functions as described below, in the following sequence:
   i. Swinging the compass.
   ii. Aligning the compass heading.
   iii. Aligning rudder bar (only if rudder reference transducer is fitted).
   iv. AutoLearn.

Swinging the compass

Note: *This section does not apply if you have connected an NMEA compass to your SPX system. Refer to the handbook supplied with the NMEA compass for information about calibration.*

The magnetic deviation correction procedure (commonly called “swinging the compass”) involves turning your boat in slow circles so the autopilot can automatically

determine the deviation and apply any correction required. The correction procedure reduces deviation errors to a few degrees.

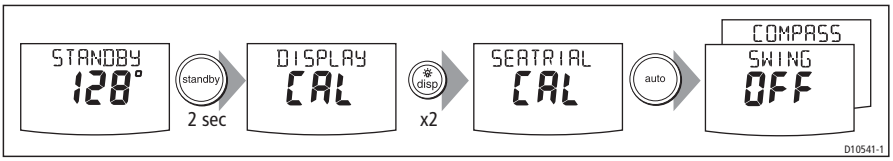
As magnetic deviation can cause significant compass errors on your boat, you **MUST** complete the compass swing before any other seatrial procedure.

To swing the compass:

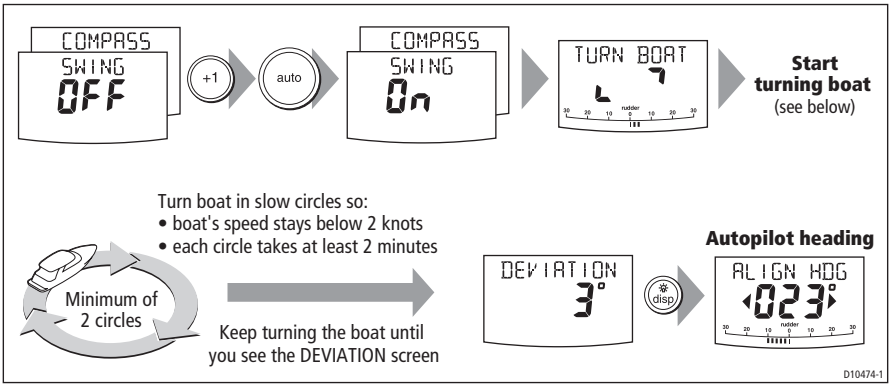
1. With the SPX-5R Drive system in Standby mode, enter Seatrial calibration as follows:
   i. Hold down standby for two seconds to enter Calibration mode.
   ii. When you see the **DISPLAY CAL** screen, press disp until you see the **SEATRIAL CAL** screen.
   iii. Press auto to enter Seatrial calibration.

Note: *If you cannot access Seatrial calibration, disable the calibration lock (see page 54).*

2. Use the disp key to page through the Seatrial calibration items until you see **SWING COMPASS.**



3. When you are ready to start, press +1, to select **SWING COMPASS ON**.
4. Press auto to start the compass swing.
   The Pilot Controller will display **TURN BOAT**. This indicates the start of the compass swing.



5. Ensuring you keep the boat's speed below 5 knots, start slowly turning the boat in circles, at a constant speed, maintaining a turn rate of approximately 3° per second, i.e. taking approximately 2 minutes to complete one turn. Complete at least two circles in this manner.
   If you turn the boat too quickly, the display will show a **TOO FAST** message. If this occurs, **apply less helm to reduce the rate of turn.**

Note: *If necessary, you can quit the correction process by pressing **standby** or **disp**. If you then want to repeat the deviation correction, return to the* **SWING COMPASS** *screen.*

6. Continue slowly turning the boat until the controller beeps and displays the **DEVIATION** screen. This indicates that the SPX-5R Drive system has completed the deviation correction.

Note: *This screen shows the maximum deviation encountered over 360° (not as an east/west value).*

If the deviation value exceeds 15° the compass is being affected by ferrous objects on your boat. If this occurs, move the compass to a better location. Higher deviation figures are acceptable on steel boats.

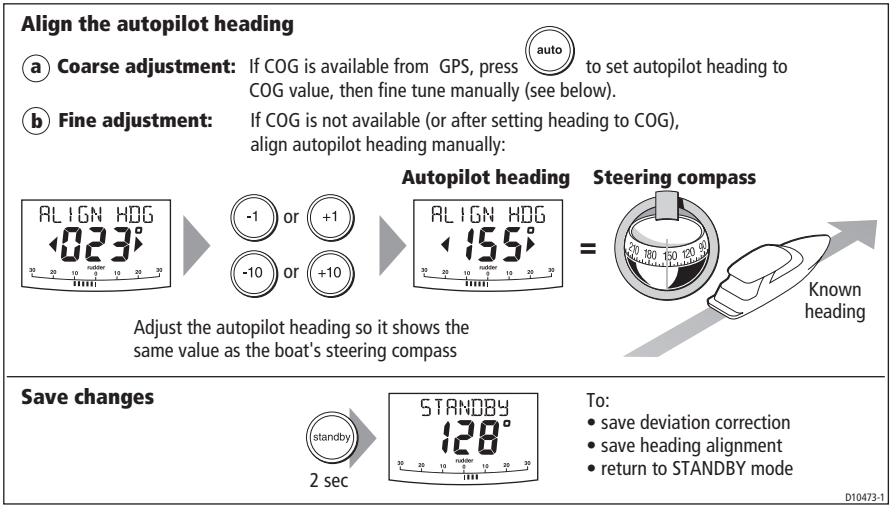
Aligning the compass heading

Once the deviation is displayed, press disp to move to the Heading Alignment page (**ALIGN HDG**), then:

1. Manually steer the boat on a steady course at a speed sufficient to hold that course.
2. If you have a GPS connected to your SPX-5R Drive system:
   i. Increase the boat speed to more than 3 knots.
   ii. Press auto. The SPX-5R Drive system will then set the heading to agree with the COG (course over ground) heading received from the GPS.

As many factors can cause a difference between heading and COG, you must fine-tune the heading alignment so it matches the boat's steering compass (or a known transit bearing). To do this:

1. Use -1, +1, -10 and +10 to adjust the displayed heading until it matches boat's steering compass (or a known transit bearing).
2. Hold down standby for 2 seconds to exit Seatrial calibration and save the new compass settings.


Align the autopilot heading
a Coarse adjustment: If COG is available from GPS, press auto to set autopilot heading to COG value, then fine tune manually (see below).
b Fine adjustment: If COG is not available (or after setting heading to COG), align autopilot heading manually:
Autopilot heading
Steering compass
ALIGN HDG
023°
-1 or +1
-10 or +10
ALIGN HDG
155°
=
Known heading
Adjust the autopilot heading so it shows the same value as the boat's steering compass
Save changes
standby
2 sec
STANDBY
128°
To:
• save deviation correction
• save heading alignment
• return to STANDBY mode
D10473-1

Although the compass calibration removes most of the alignment error, small errors (a few degrees) may remain. Once you have completed the initial compass calibration, you can make further adjustments to the alignment without having to swing the compass again.

Check the heading reading against a number of known headings, plot a deviation curve, and determine the heading alignment value that will give the lowest **average** alignment error. You can then enter this value on the Heading Alignment screen, as described above.

If the average heading error is more than 5°, check there are no items close to the compass that could cause an unwanted magnetic influence. You should also consider moving the fluxgate compass and performing the compass deviation correction procedure again, circling more slowly and in more favorable conditions.

Aligning rudder bar

If the rudder reference transducer is fitted, use this procedure to align the rudder bar on the Pilot Controller display:

1. Access the **ALIGN RUDDER** screen in Seatrial calibration:
   i. From Standby mode, hold down standby for 2 seconds, then press disp twice to see the **SEATRIAL CAL** screen.
   i. Press auto to enter Seatrial calibration, then press disp tree times to see the **ALIGN RUDDER** screen
2. Steer straight ahead then use -1, +1, -10 and **+10** or the rotary control to set the displayed rudder bar to zero.

AutoLearn

CAUTION:

When using Autolearn you must have significant clear water both in front and to the sides of the vessel. This is needed to accommodate a series of maneuvers, which include sudden, sharp turns.

The next stage of the Seatrial is to carry out an AutoLearn routine. This is a self-learning calibration feature that automatically adjusts rudder gain, counter rudder and AutoTrim for optimum performance on your boat.

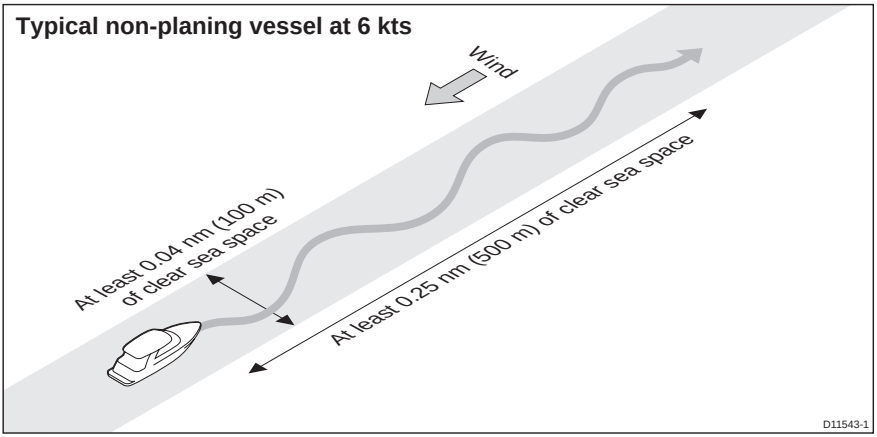
If you need to return to manual steering at any time during an AutoLearn routine or any other procedure, **press the** standby **button**. NEVER compromise vessel safety.

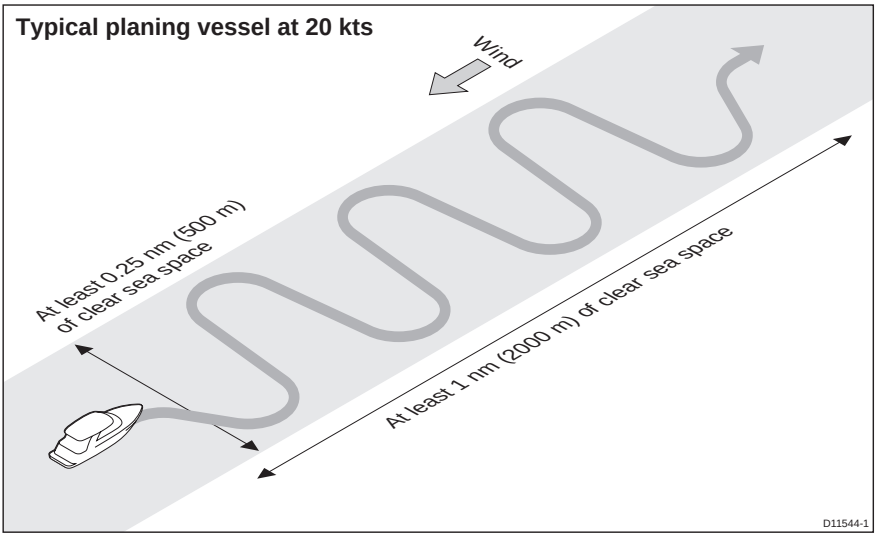
Clear water

The Autolearn set up feature performs a series of 7 or 8 turns at normal cruising speed. The amount of clear water required depends upon the cruising speed of your vessel.

For example:

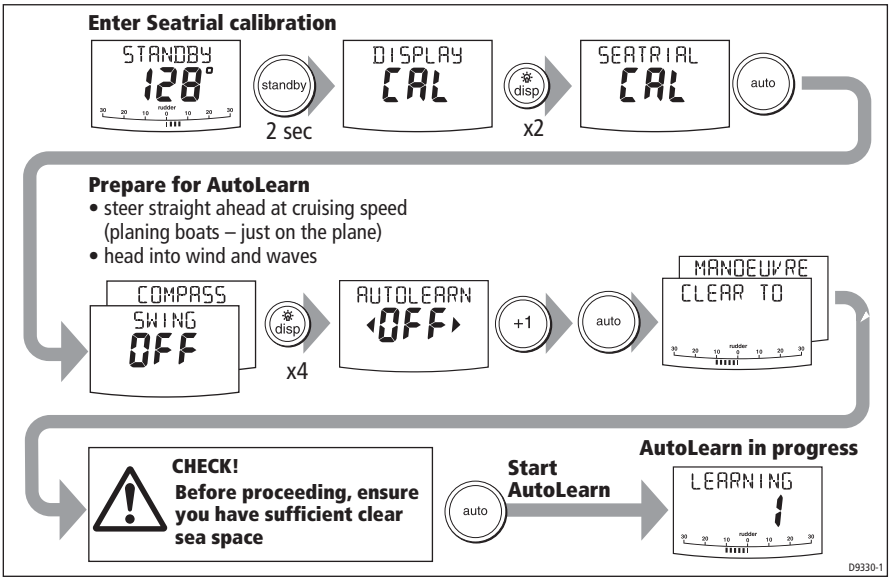
- Minimum 100 m wide and 500 m ahead (typical non-planing vessel at 6 kts).
- Minimum 500 m wide and 2000 m ahead (typical planing vessel at 20 kts).


Typical non-planing vessel at 6 kts
Wind
At least 0.04 nm (100 m) of clear sea space
At least 0.25 nm (500 m) of clear sea space
D11543-1



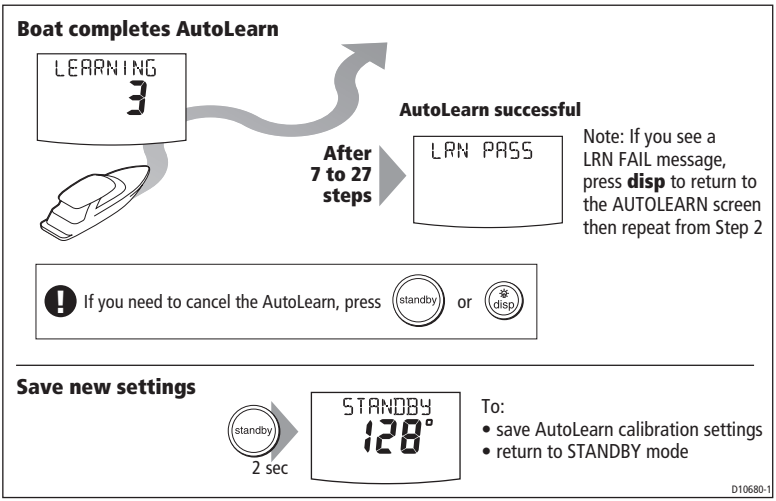
AutoLearn procedure

1. If you are not already in Seatrial calibration:
   i. From Standby mode, hold down `standby` for 2 seconds, then press `disp` twice to see the **SEATRIAL CAL** screen.
   ii. Press `auto` to enter Seatrial calibration.
   iii. Press `disp` four times to see the **AUTOLEARN** screen.
2. In Seatrial calibration, press `disp` as necessary, until the **AUTOLEARN** screen is displayed.


Enter Seatrial calibration
STANDBY
128°
standby
2 sec
DISPLAY
CAL
disp
x2
SEATRIAL
CAL
auto
Prepare for AutoLearn
• steer straight ahead at cruising speed (planing boats – just on the plane)
• head into wind and waves
COMPASS
SWING
OFF
disp
x4
AUTOLEARN
OFF
+1
auto
MANOEUVRE
CLEAR TO
CHECK!
Before proceeding, ensure you have sufficient clear sea space
auto
Start AutoLearn
AutoLearn in progress
LEARNING
1
D9330-1

3. With the **AUTOLEARN** screen displayed, prepare to start the AutoLearn:
   - **power boats:** steer straight ahead (rudder centered). For non-planing boats, set a comfortable cruising speed. For planing boats set the speed so the boat is just planing.
   - **sail boats:** with the sails down, steer straight ahead (rudder centered) and motor the boat at typical cruising speed.
4. If conditions are not calm, head into the wind and waves.
5. When you are ready to start the AutoLearn, press +1.
6. Press auto. The screen will then show the **CLEAR TO MANOEUVER** message.
7. Ensure it is safe to continue, then press auto to start the AutoLearn maneuvers:
   - The boat will start a series of zig-zag turns and the display will show **LEARNING** with a number to indicate the current AutoLearn stage. This number increases as AutoLearn progresses.
   - A typical AutoLearn completes within 7 to 27 steps (depending on boat characteristics and sea conditions).

Note: *To cancel an AutoLearn, press **standby** or **disp**.*



8. When the SPX-5R Drive system has finished learning, the controller will beep and display either **LRN PASS** or **LRN FAIL**:
   - **LRN PASS** = AutoLearn completed successfully.
   - **LRN FAIL** = AutoLearn was not successful, so should be repeated. A failure code is also displayed:
     1 = AutoLearn has not been carried out.
     2 = AutoLearn failed, due to manual interruption.
     3 Not used.
     4 = AutoLearn failed, probably due to drive or compass failure.
     5 = AutoLearn failed, probably due to motor current limiting.
     6 = AutoLearn failed, probably due to boat locking in a turn.

9. If the AutoLearn was successful, hold down standby for 2 seconds to store the new settings.

Commissioning complete

If you have successfully completed the dockside preparation and seatrial calibration, the SPX system is now commissioned and ready for use.

After having used your SPX-5R Drive system, you may decide to change the value of some parameters to improve pilot performance with your boat. If you feel this is necessary, use the appropriate procedures under *Manual setup*, below.

3.2 Manual setup

Checking SPX-5R Drive system operation

Before manually adjusting any settings, familiarize yourself with basic SPX-5R Drive system operation, as follows:

1. Steer onto a compass heading and hold the course steady at a normal cruising speed. If necessary, steer the boat manually for a short time to check how the boat steers.
2. Press auto to lock onto the current heading. The SPX-5R Drive system should hold a constant heading in calm sea conditions.
3. Use -1, +1, -10 and +10 to see how the SmartPilot alters the course to port and starboard.
4. Press standby to return to manual steering.

Adjustable parameters

If you feel you need to fine tune the SPX-5R Drive system performance, you can do so by using one or more of the procedures below to adjust:

- Rudder gain.
- Counter rudder
- AutoTrim.

Over time you may wish to repeat these adjustments using a range of sea conditions and headings to achieve optimum all-round performance for your particular vessel and preferences.

Adjust these settings when motoring your boat at cruising speed. For further information on adjustable parameters, refer to *Chapter 4: SmartPilot X-5R Drive Settings*.

Setting response level

Before proceeding with any manual adjustment, set the response level to **5** as follows:

1. Enter Dealer calibration as described on *page 35*.
2. Use disp as necessary to access the **RESPONSE** screen.
3. Use the -1 or +1 key or the up and down arrow keys to set a response of **5**.
4. Hold down standby for 2 seconds to save the setting and leave Dealer calibration.

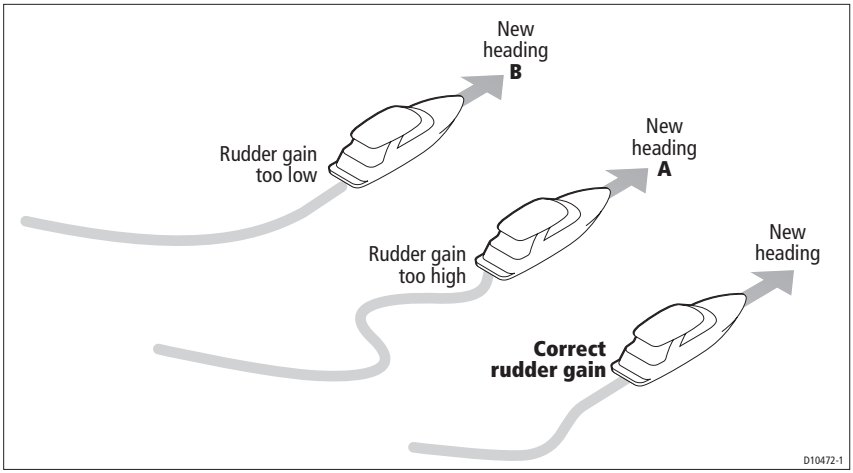
Rudder gain

Boats can vary widely in their response to helm, and by adjusting the rudder gain you can change the SPX-5R Drive system's steering characteristics. Rudder gain is a measure of how much helm the SPX-5R Drive system applies to correct course errors – higher settings mean more rudder is applied.

Checking

Complete the following test to determine whether the rudder gain is set correctly:

1. Ensure you have set the SPX-5R Drive response to level **5**, as described above.
2. Motor your boat at a typical cruising speed in clear water.
   It is easier to recognize the steering response in calm sea conditions where wave action does not mask steering performance.
3. Press auto to enter Auto mode, then alter course by 40°:
   - if the rudder gain is adjusted correctly, the 40° course change should result in a crisp turn followed by an overshoot of no more than 5°.
   - if the rudder gain setting is too high, the 40° course change will result in a distinct overshoot of more than 5° and there may be a distinct 'S' in the course **(A)** Correct this oversteer by **reducing** the rudder gain setting.
   - if the rudder gain is too low, the boat's performance will be sluggish – it will take a long time to make the 40° turn and there will be no overshoot **(B).** Correct this understeer by **increasing** the rudder gain setting.



Adjusting

To adjust the rudder gain:

1. Enter Dealer calibration as described on *page 35*.
2. Use disp as necessary to access the **RUDD GAIN** screen.
3. Use -1 or **+1** to adjust the rudder gain.
4. Hold down standby for 2 seconds to save the changes and leave Dealer calibration.
5. Press auto to check the SPX-5R Drive system performance in Auto mode.

Counter rudder

Counter rudder is the amount of rudder the SPX-5R Drive system applies to try to prevent the boat from oversteering. Higher counter rudder settings result in more rudder being applied.

Checking

To check the counter rudder setting:

1. Ensure you have set the response to level **5**, as described above.
2. Motor your boat at cruising speed in clear water.
3. Press auto to switch the SPX-5R Drive system to Auto mode, then make a 90° course change:
   - When gain and counter rudder are both set correctly, the boat performs a smooth continuous turn with minimal overshoot.
   - If the counter rudder is too low, the boat will still overshoot.
   - If counter rudder is too high, the boat will 'fight' the turn and make a series of short, sharp turns: this results in a very 'mechanical' feel as the boat changes course.

Adjusting

To adjust the counter rudder:

1. Enter Dealer calibration as described on *page 35*.
1. Access the **COUNT RUD** screen in Dealer calibration.
2. Use the **-1** or **+1** keys to adjust the counter rudder.
3. Press and hold **standby** for 2 seconds to save the changes and leave Dealer calibration.
4. Press **auto** to check the SmartPilot performance in Auto mode.

AutoTrim

You may also wish to adjust the AutoTrim setting. AutoTrim determines how quickly the SPX-5R Drive system applies 'standing helm' to correct for trim changes, caused, for example, by changes in the wind load on the superstructure, or an imbalance of engines.

Increasing the AutoTrim level reduces the time the SPX-5R Drive system takes to get back onto the correct course, but makes the boat less stable. If the SPX-5R Drive system:

- Gives unstable course keeping and the boat 'snakes' around the desired course, **decrease** the AutoTrim level.
- Hangs off course for excessive periods of time, **increase** the AutoTrim level.

Adjusting

Before attempting to adjust the AutoTrim setting, ensure you have sufficient experience using your SPX-5R Drive system.

If you need to adjust AutoTrim, go up one level at a time and use the lowest acceptable value. The range of settings is from **OFF** (no trim correction) to **6** (fastest trim correction).

To adjust the AutoTrim

1. Enter Dealer calibration as described on *page 35*.
1. Use disp as necessary to access the **AUTOTRIM** screen.
2. Use -1 or +1 to adjust the AutoTrim level.
3. Press and hold standby for 2 seconds to save the changes and leave Dealer calibration.
4. Press auto to check the SPX-5R Drive system performance in Auto mode.

Rudder damping

If a rudder reference transducer is fitted, you can set the SPX-5R Drive system rudder damping to prevent autopilot 'hunting', i.e. continuously moving the steering backwards and forwards by small amounts. To set up the rudder damping:

1. Enter Dealer calibration as described on *page 35*.
2. Use disp as necessary to access the **RUDD DAMP** page.
3. Use -1, +1, -10 and +10 to set the rudder damping so the hunting stops. Use the lowest rudder damping value at which hunting stops.
4. Hold down standby for 2 seconds to save the changes and leave Dealer calibration.

Chapter 4: SmartPilot X-5R Drive Settings

4.1 Introduction

This chapter describes the SPX-5R Drive system calibration settings and the factory default settings. The calibration settings can be adjusted to best suit your operating requirements, but as many will have been adjusted to optimum values when commissioning the system, they should not require further change.

If you change the calibration settings after the SPX-5R Drive system has been commissioned, you do not need to repeat the commissioning process. However, DO NOT manually adjust autopilot settings before the commissioning procedures in *Chapter 3* have been completed.

Calibration modes

There are four calibration modes, namely Display calibration, User calibration, Seatrial calibration and Dealer calibration.

Each calibration mode uses a series of screens to set calibration values.

Display Calibration

The items in Display Calibration affect the SPX-5R Drive system Pilot Controller. They are stored in the controller and do not affect any other controllers connected through SeaTalk.

You can adjust the Display Calibration settings as often as necessary – for example, to add or change information displayed on data pages.

User calibration

The User calibration group includes settings that you may need to adjust on a regular basis due to changing conditions.

Seatrial calibration

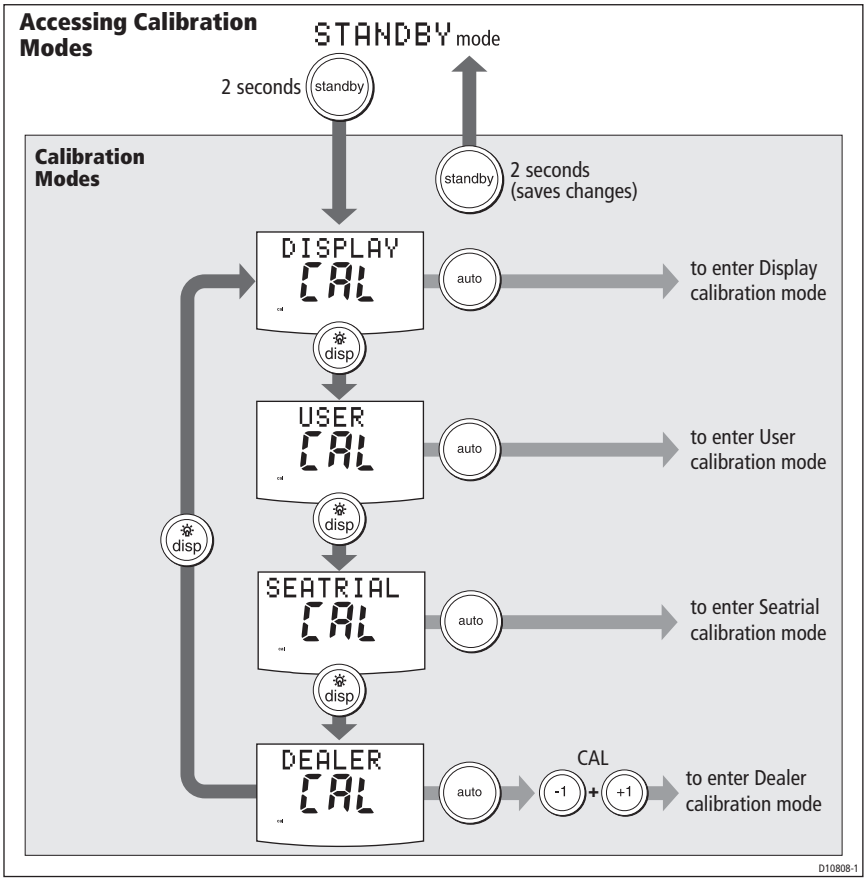
The Seatrial calibration mode is used ONLY when commissioning your SPX-5R Drive system, as described in *Chapter 3,* so is not described again here. **Do not access Seatrial calibration during normal operation**.

Dealer Calibration

The Dealer calibration mode includes items that have a significant impact on operation and can affect your boat's safety.

After you have completed the initial installation and seatrial, you should not normally need to alter the Dealer calibration values.

Accessing the Calibration modes



Adjusting calibration values

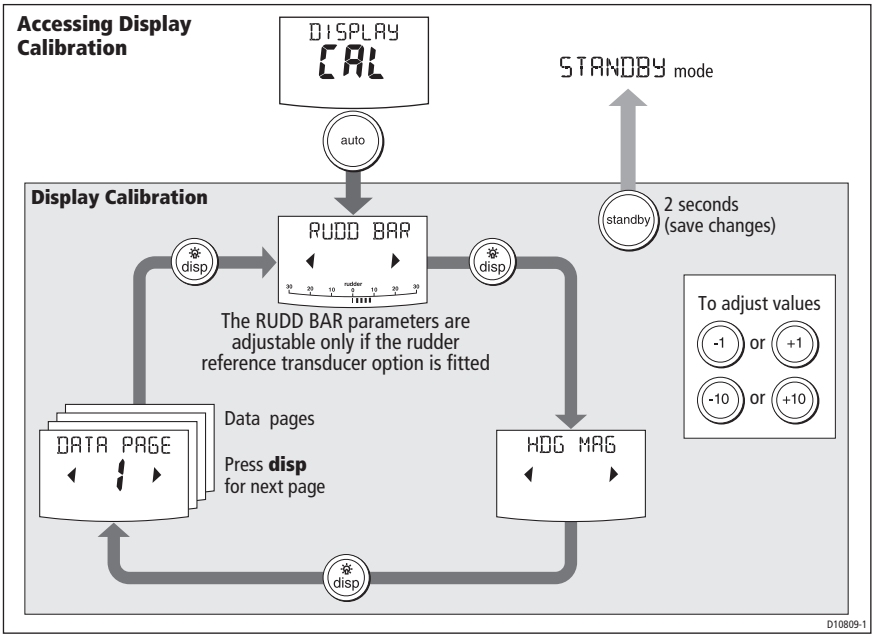
To adjust calibration values:

1. Access the required calibration mode (refer to the diagram above).
2. Press disp to scroll through the available options. To view the previous option, press and hold disp for 1 second.
3. Use -1, +1, -10 and +10 to change the values

When you have made all required changes, press and hold standby for 2 seconds to save changes and exit.

4.2 Display calibration

Display calibration provides settings to adjust the information displayed on the Pilot Controller.



RUDD BAR screen

This screen gives you access to the other Display calibration screens.

Heading screen

Use the Heading (**HDG**) screen to choose whether to use magnetic or true heading data values. The options are:

- **HDG MAG** - Magnetic heading. If you select this, the screen will indicate **MAG** for heading values, during normal operation.
- **HDG TRUE** - True heading. If you select this the screen will indicate **TRUE** for heading values, during normal operation.

Data pages

The Pilot Controller has fifteen user-configurable data pages. Each data page can be configured to display SeaTalk/NMEA data, which can be viewed during normal normal operation (see *SmartPilot X-5R Drive Operating Guide*).

The default page settings are:

Data Page	Default Setting
1	**XTE** (Cross Track Error)
2	**BTW** (Bearing to Waypoint) - see Note below
3	**DTW** (Distance to Waypoint) - see Note below
4	**RESPONSE**
Remaining pages	**NOT USED** (see *Setting up data pages* below)

Setting up data pages

When setting up your data pages, we recommend that you:

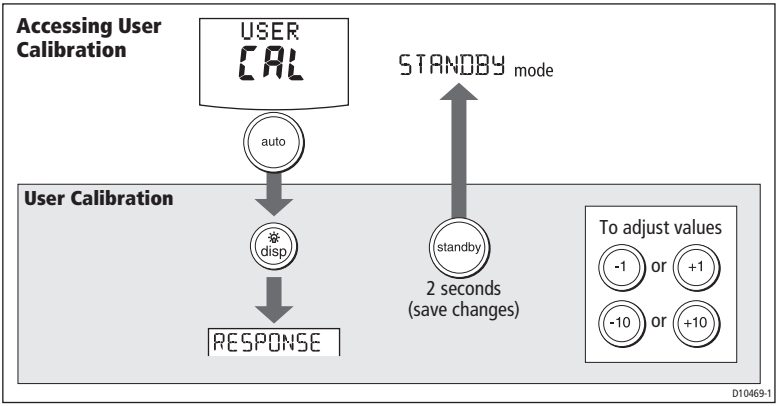
- Retain the **BTW** and **DTW** data pages. If your SPX-5R Drive system receives a man overboard (MOB) message, these data pages will show the bearing and distance to the MOB location.
- Disable data pages you do not need to **NOT USED**. These will then not be displayed during normal operation, thereby improving the access time to the other data pages..

Available Data Pages	Displayed as
Speed Knots	**SPEED KTS**
Log	**LOG XXXX**.X
Trip	**TRIP XXX.X**
Average Speed	**AV. SPD**
Wind Direction	e.g. **WIND PORT**
Wind Speed	**WIND KTS**
Depth Metres	**DEPTH M** - see Note below
Depth Feet	**DEPTH FT** - see Note below
Depth Fathoms	**DEPTH FA** - see Note below
Heading	**HEADING**
Water Temperature, Degrees C	**WATER °C** - see Note below
Water Temperature, Degrees F	**WATER °F** - see Note below
Course Over Ground	**COG**
Speed Over Ground, Knots	**SOG KTS**
Cross Track Error	**XTE**
Distance to Waypoint	**DTW**

Available Data Pages	Displayed as
Bearing to Waypoint	**BTW**
Rudder Gain	**RUDD GAIN**
Response	**RESPONSE**
Watch	**WATCH** - used to control the Watch timer
Universal Time Coordinated	**UTC**

Note: *There are 3 depth pages (meters, feet and fathoms) and 2 water temperature pages (°C and °F). The SPX-5R Drive system will display the depth data or water temperature in the units defined by data page you select.*

4.3 User calibration



For information on how to access calibration mode see *Accessing the Calibration modes* on *page 50*.

Response level

The User calibration function gives access to the response level setting.

The response level screen enables you to set the default SPX-5R Drive system response level setting. The response level controls the relationship between course keeping accuracy and the amount of helm/drive activity. You can make temporary changes to response during normal operation, as described in *Smart Pilot X-5R Drive System Operating Guide*.

Screen Text	Options
RESPONSE	Range = 1 to 9 **Levels 1 to 3** minimize the amount of pilot activity. This conserves power, but may compromise short-term course-keeping accuracy. **Levels 4 to 6** should give good course keeping with crisp, well controlled turns under normal operating conditions **Levels 7 to 9** give the tightest course keeping and greatest rudder activity (and power consumption). This can lead to a rough passage in open waters as the SPX-5R Drive system may 'fight' the sea.

4.4 Dealer calibration

For information on how to access Dealer calibration, refer to *Accessing the Calibration modes* on *page 50*.

WARNING: Dealer calibration

Changing the Dealer calibration values can have a significant affect on the SPX-5R Drive system steering characteristics and therefore on the safety of your boat.

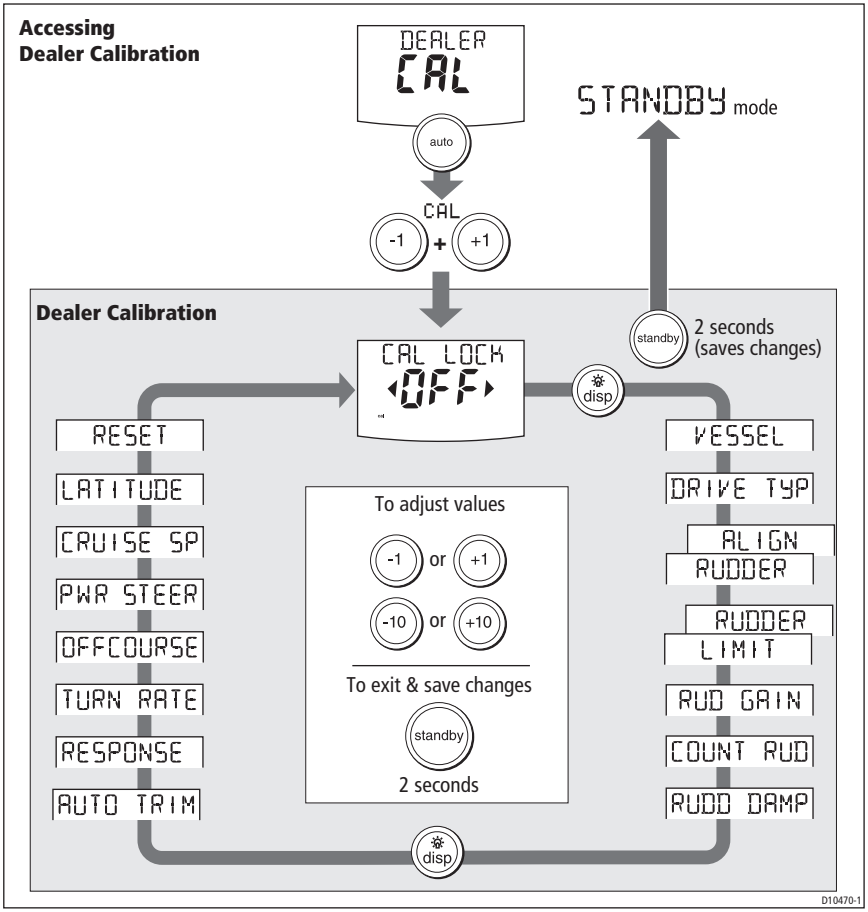
Some Dealer calibration values are adjusted during the commissioning process (see *Section Chapter 3: Commissioning & Setup*), and once the SPX-5R Drive system has been commissioned, you should not normally need to change Dealer calibration values.

However if you decide you want to change values in Dealer calibration, be aware that the Dealer calibration mode includes items that have a **significant impact on SPX-5 Drive system operation and can affect your boat's safety**.

Seatrial calibration lock

This screen controls the access to Seatrial calibration.

Screen text	Options
CAL LOCK OFF	Calibration lock off – Seatrial calibration can be accessed (default)
CAL LOCK ON	Calibration lock on – Seatrial calibration cannot be accessed



Vessel type

Selecting the correct vessel type, enables the SPX-5R Drive system to set appropriate values for other calibration settings, to give optimum performance. Refer to the table on *page 60* for default values.

Options	Vessel type
DISPLACE	Power-driven boats which do not plane (Typically below 15 kts top speed)
SEMI DISPLACE	Faster power-driven boats which do not plane (Typically 15-20 kts top speed)
PLANING	Planing boats with inboard engine(s) and shaft drives (NOT boats with outdrives)

Options	Vessel type
STERN DRV	Boats with outdrives or outboard engines, including Mercury Verado and Volvo Penta IPS.
WORK BOAT	Commercial tugs, fishing vessels, etc
SAIL BOAT	Not applicable to the SPX-5R Drive system.

Drive type

The drive type setting controls how the SPX-5R Drive system drives the steering system.

The correct setting for the SPX-5R Drive system is **3**. This should be set when commissioning the SPX-5R Drive system.

Align rudder

The align rudder screen is displayed only if the rudder reference option is fitted.

If the rudder reference option is fitted, use this screen is used to calibrate the rudder bar display. This should be set when commissioning the SPX-5R Drive system (see *page 36*).

Screen Text	Range
ALIGN RUD	-9° to +9° in 1° steps

Rudder limit

The rudder limit screen is displayed only if the rudder reference option is fitted.

If the rudder reference option is fitted, this screen is used to set the limits of the rudder control just inside the mechanical end stops, to thus avoid putting the steering system under unnecessary load. This should be set when commissioning the SPX-5R Drive system *(see page 36).*

Screen Text	Range
RUD LIMIT	10° to 40° in 1° steps

Rudder gain

Rudder gain is a measure of how much helm the SPX-5R Drive system applies to correct course errors. The higher the setting the more rudder will be applied.

The rudder gain setting is set automatically as part of the AutoLearn process (see *page 45*).

Screen Text	Range
RUD GAIN	1 to 9

Counter rudder

Counter rudder is the amount of rudder the SPX-5R Drive system applies to try to prevent the boat from oversteering. Higher counter rudder settings result in more rudder being applied.

The default counter rudder gain is set during the initial seatrial AutoLearn process (see *page 40*).

Screen Text	Range
COUNT RUD	1 to 9

Rudder damping

If the SPX-5R Drive system 'hunts' when trying to position the rudder, adjust the rudder damping value to minimize this. Increasing the rudder damping value reduces hunting. Increase the damping one level at a time until the autopilot stops hunting, and always use the lowest acceptable value

Screen Text	Range
RUDD DAMP	1 to 9

AutoTrim

The AutoTrim setting determines the rate at which the SPX-5R Drive system applies 'standing helm' to correct for trim changes.

The default AutoTrim is set as part of the AutoLearn process (see *page 40*).

If you need to change the setting, increase the AutoTrim one level at a time and use the **lowest** acceptable value:

- If the SPX-5R Drive system gives unstable course keeping or excessive drive activity, decrease the AutoTrim level.
- If the SPX-5R Drive system takes too long to settle onto a new course, increase the AutoTrim level
- If the AutoTrim level is too high, the boat will be less stable and snake around the desired course

Setting	Effect
AUTO TRIM OFF	No trim correction
AUTO TRIM 1 to **4**	Auto trim applied: 1 = Slowest, 4= Fastest

Response level

This sets the default SPX-5R Drive system response level setting. The response level controls the relationship between course keeping accuracy and the amount of helm/drive activity. You can make temporary changes to response during normal operation (see your *Operating Guide* for details).

Screen Text	Options
RESPONSE	Range = 1 to 9 **Levels 1 to 3** minimize the amount of pilot activity. This conserves power, but may compromise short-term course-keeping accuracy. **Levels 4 to 6** should give good course keeping with crisp, well controlled turns under normal operating conditions. **Levels 7 to 9** give the tightest course keeping and greatest rudder activity (and power consumption). This can lead to a rough passage in open waters as the SPX-5R Drive system may 'fight' the sea.

Turn rate limit

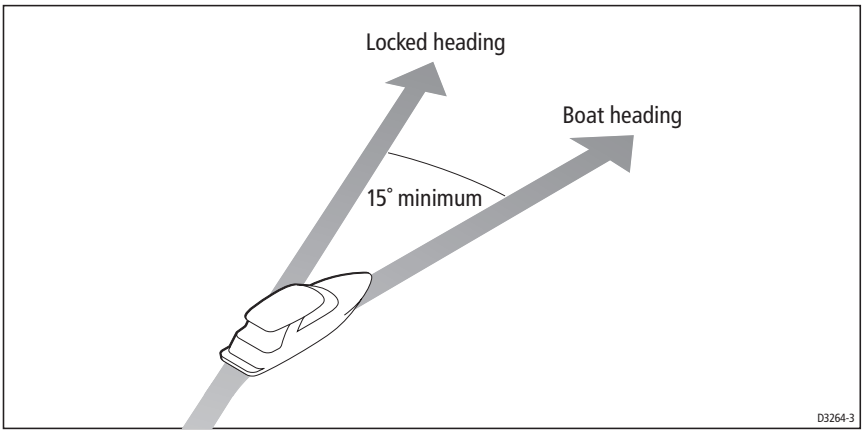
This limits your boat's rate of turn under SPX-5R Drive system control.

Screen Text	Range
TURN RATE	1° to 30° per second in 1° steps

Off course angle

This screen determines the angle used by the **OFF COURSE** alarm (see your *Operating Guide*). The **OFF COURSE** alarm operates if the pilot strays off course by more than the specified angle for more than 20 seconds.

Screen Text	Range
OFF COURSE	15° to 40° in 1° steps



PowerSteer

If you have a joystick connected to your SPX-5R Drive system, use this screen to select the required joystick mode of operation. For detailed operating information, refer to the guide supplied with the joystick.

Options	
OFF	Joystick off
1	Proportional power steer Proportional power steer applies rudder in proportion to joystick movement – the further the joystick is held over, the greater the applied rudder.
2	Bang-bang power steer Bang-bang power steer applies continuous rudder in the direction of the lever movement – to improve control, the speed of rudder movement changes with the angle of the lever. For maximum speed, push the lever hardover. If you return the lever to the center position, the rudder will remain in its current position.

Cruise speed

Sets the cruise speed value to the boat's typical cruising speed. If neither the speed through the water nor the speed over ground are available via SeaTalk or NMEA, the SPX-5R Drive system will use the cruise speed value you set here as a default when when adjusting autopilot settings.

Screen Text	Range
CRUISE SP	4 to 60 knots

Latitude

If valid latitude data is available via SeaTalk or NMEA, the SPX-5R Drive system will use this data instead of the calibration value.

Screen Text	Range
LATITUDE	0° to 80° in 1° steps

System reset

CAUTION: Losing settings at system reset

Do NOT select System RESET unless advised to do so by a Raymarine dealer. If you complete a reset you will lose the SPX-5R Drive system calibration settings. You will then need to repeat the SPX-5R Drive system commissioning process.

Carrying out a System reset will reset User calibration, Seatrial calibration and Dealer calibration settings to their default values.

Note: *the Display calibration settings will not change, as these are stored in each individual controller.*

To carry out a system reset:

1. Select the System reset (**RESET**) screen in Dealer calibration.
2. Press +1, then press auto.

3. The screen will then show an **ARE YOU SURE** message. Either:
   - Press auto to cancel the reset

   or
   - Press +1 again to select **YES** and reset the SPX-5R Drive system.
4. You will then see the **CAL LOCK** screen:
   - Hold down standby for 2 seconds to save the new default settings, then turn the SPX-5R Drive system computer power off and back on

If you reset the system parameters, you must carry out the SPX-5R Drive system commissioning process before using the SPX-5R Drive system again.

4.5 System defaults

Vessel type	Factory Defaults	Displacement	Semi-Displace-ment	Planing	Stern Drive	Work Boat
Calibration Lock	OFF	OFF	OFF	OFF	OFF	OFF
Vessel Type	0	DISPLACE	SEMI DISPLACE	PLANING	STERN DRV	WORK BOAT
Drive Type	3	4	4	4	3	4
Rudder Alignment	0	0	0	0	0	0
Rudder Limit	30	30	30	20	20	30
Rudder Gain	4	5	4	4	4	5
Counter Rudder	4	3	5	5	5	2
Rudder Damping	2	2	2	2	2	3
AutoTrim	2	2	3	3	3	2
Response:	5	5	5	5	5	5
Turn Rate Limit	7	7	7	7	5	7
Off Course Angle	20	20	20	20	20	20
Power Steer (Joystick)	OFF					
Cruise Speed	8	8	8	8	20	8
Latitude	0	0	0	0	0	0
Autopilot Reset	OFF	OFF	OFF	OFF	OFF	OFF

Appendix 1: NMEA 0183 sentences

The SPX-5R Drive system Course Computer supports the following NMEA0183 sentences.

NMEA0183 to Course Computer

Header	Data in
APB	Cross track error, bearing to waypoint, waypoint number
BWC BWR	Bearing to waypoint, distance to waypoint, waypoint number, time
GGA GLL	Latitude/longitude, time
HDG HDM HDT	Heading
MWV	Apparent wind angle, apparent wind speed
RMA	Course over ground (COG), speed over ground (SOG), latitude/longitude, variation
RMB	Cross track error, bearing to waypoint, distance to waypoint, waypoint number
RMC	Course over ground (COG), speed over ground (SOG), latitude/longitude, time, variation
VHW	Speed through water, heading
VTG	Course over ground (COG), speed over ground (SOG)
XTE	Cross track error
ZDA	Time, date

NMEA0183 from Course Computer*

Header	Data out
HDG	Heading

***** The computer will only transmit NMEA if it has received the appropriate data.

Appendix 2: SPX-5R Drive system specifications

Course Computer

Nominal supply voltage	12 V dc (From course computer only) (20 A fuse protection at distribution panel) (15 A thermal circuit breaker protection at distribution panel)
Operating voltage range	11 V to 16 V DC
Current consumption (maximum)	200 mA
Rate Gyro	Built in
Environmental conditions: • operating temperature • storage temperature • relative humidity limit • water protection	 -10°C to 50°C (14°F to 122°F) -20°C to 65°C (-4°F to 149°F) 85% Relative Humidity (non condensing) water ingress protection to IPX6, when mounted vertically
Dimensions:	Width: 240 mm (9 $^{7}/_{16}$“), Height: 170 mm (6 $^{11}/_{16}$“), Depth: 55 mm (2 $^{3}/_{16}$“)
Inputs	Fluxgate Compass, NMEA 0183 v3.01, SeaTalk (x2), SeaTalk^{ng}, power
Outputs	NMEA 0183 v3.01, SeaTalk (x2), drive motor, SeaTalk^{ng}
Raymarine drive compatibility:	Drive (as supplied with product)
Drive motor output:	5 A nominal 10 A peak
SeaTalk output	2A at 12 V (fuse protected at 2A)
NMEA 0183 v2.3 inputs/outputs	See *Appendix 1:, NMEA 0183 sentences*
NMEA fast heading output	HDG 5 Hz 0.1° resolution
Fuses Power Terminals SeaTalk Terminals	Standard automotive blade fuses to protect: 15 A 2 A
EMC compliance:	Europe 2004/108/EC (EMC) Australia and New Zealand: C-Tick, Compliance Level 2

Drive

Nominal supply voltage	12 V dc
Operating voltage range	10 V to 16 V dc

Environmental conditions: • operating temperature • storage temperature • relative humidity limit • water protection	 -10°C to 50°C (14°F to 122°F) -20°C to 65°C (-4°F to 149°F) 95% Relative Humidity (non condensing) water ingress protection to IPX6, when mounted vertically
Inputs	Drive power from compatible Course Computer.
Steering load: • Maximum continuous • Maximum instantaneous	 5 pound feet (7 Newton meters) 11 pound feet (15 Newton meters)
Manual steering torque	2 pound feet (3 Newton meters)
Servicing	**Daily inspection before commencing any passage:** - Visually inspect the Drive installation. - Check autopilot operation. **Annual inspection:** Check once per year that the Drive, and associated torque restraint are securely fitted and have not worked loose during usage. Remove any deposits from the emergency release pin and check its operation. **Service interval:** Inspect and service in line with your steering system manufacturer recommendations. In any event a Raymarine approved service must be carried out every 2 years or 200 engine hours, whichever occurs soonest.
CE compliance and approvals	2004/108/EC (EMC). EN29775 Section 7.2.2 Helm assembly tests. BSEN28848 Helm impact test. Australia and New Zealand: C-Tick, Compliance Level 2.

Pilot Controller (ST6002)

Nominal supply voltage:	12 V dc via SeaTalk
Operating voltage range:	10 V to 16 V dc
Current consumption (Standby mode)	60 mA (less than 200 mA with full lighting)
Environmental conditions: • operating temperature • storage temperature • relative humidity limit • water protection	 -10°C to 50°C (14°F to 122°F) -20°C to 65°C (-4°F to 149°F) 95% Relative Humidity (non condensing) water ingress protection to IPX6.
Overall dimensions: • width • height • depth	 110 mm (4.33 in) 115 mm (4.53 in) 41 mm (1.62 in)
Keypad:	8 button illuminated keypad
Liquid Crystal Display (LCD):	shows heading, locked course and navigational data, and up to 15 data pages
LCD illumination:	3 brightness levels + off
Input connections:	SeaTalk (x2) and NMEA 0183
Output connections:	SeaTalk (x2)
CE approvals:	Europe 2004/108/EC (EMC). Australia and New Zealand: C-Tick, Compliance Level 2.

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